Stress management in crisis event simulations for enhancing performance

Stress Management in Crisis Event Simulations for Enhancing Performance

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Stress Management in Crisis Event Simulations for Enhancing Performance

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CONTENTS

CHAPTER 1

Introduction

BACKGROUND

Optimum clinical performance of healthcare professionals is essential to deliver safe and quality care to patients. The objective, hence, of every learning institution is to prepare health professions' trainees to enter practice with an adequate level of competency required in the performance of their clinical duties and responsibilities. Clinical performance is affected by a variety of factors, and is not only reliant on the technical skills of the clinician. Non-technical skills, such as the ability to cope with stressful situations, also contribute to how well one functions in the clinical environment, in particular during critical medical moments.

Nurses, especially those in acute settings, being the forefront of patient care, daily encounter high-acuity events that might trigger stress. The clinical environment offers challenges that may even be too stressful for nurses, especially for novices or nursing students (Elliot, 2002) who lack the experience in the actual hospital setting. The inadequate clinical knowledge and skills of novice nurses are thought to contribute to the stress in their initial clinical experiences (Sheu, Lin & Hwang, 2002). For nursing students, it has been argued that stress is synonymous with exposure to the clinical setting as this exposure triggers feelings of anxiety due to unfamiliar clinical situations (Gorostidi, et al., 2007).

Stress is an emotion-related response that results from exposure to various emotionally-charged clinical events (LeBlanc, 2009; Gorostidi, et al., 2007). It has been noted that the anxiety generated by these stressful clinical experiences may inevitably affect learning and

clinical performance (Melincavage, 2011; Piquette Reeves & LeBlanc 2009). Excessive stress may indirectly impact quality of care and patient outcomes, and may contribute to negative behaviors such as absenteeism (Chan, So & Fong, 2009; LeBlanc, 2009). Indeed, stressors, such as sudden clinical crisis events, may pose significant effects to health professionals, no matter what discipline. Exposure to stressful events can affect their ability to effectively execute clinical actions, and careful analysis and a sound decision-making processes may also be influenced (LeBlanc, 2009). However, stress and performance studies that have been conducted have had equivocal results. On one hand, stress has been thought to adversely affect performance (Arora et al. 2010; LeBlanc et al. 2012) and on the other, it has been shown to improve performance when experienced in the right amounts (DeMaria et al. 2010). Figure 1 illustrates the relationship between stress and performance.

Figure 1. Stress and Performance

Stress and emotions are closely linked as stress can also be considered as an emotional response (Lazarus, 1999). A strategy, therefore, that facilitates emotional training in the form of stress management training should be considered as part of the curricula. Since the use of simulations has been shown as an effective tool for student learning (Alinier, Hunt & Gordon, 2004; Issenberg, McGaghie, Petrusa, Gordon & Scalese, 2005), integration of a stress management strategy into a simulation-based programme could be considered. Such a move will prove to be beneficial to nursing students and to other health professions' trainees (Liaw, et al., 2012; Harvey, Nathens, Bandiera & LeBlanc, 2010).

In nursing education, simulation has been effectively used to improve students' skill performance (Alinier, et al., 2004). Simulation training provides trainees with opportunities to function and perform clinical skills in realistic settings, in many cases with standardised patients (SPs). As such, the more realistic a simulation experience is, the more it elicits emotional responses from the learners that approximate those in actual settings (Flanagan, Nestel and Joseph, 2004). Authentic simulations, therefore, elicit stress in the learners that is viewed upon as similar to that felt in real clinical experiences. The physical and psychological fidelity of these simulations has the potential to train learners in managing their emotions and in coping with stress when they encounter the same situations in actual practice (Müller, et al., 2009). The use of simulations, therefore, as a modality to train emotional responses, such as stress, is definitely of value. Yet, most of the simulation training provided by healthcare institutions are focused on skill mastery among novice healthcare professionals or

trainees. There is very less emphasis on emotional response training, such as stress management training, during simulations conducted throughout their education.

The overarching aim of this thesis, therefore, was to create and integrate into a simulation programme an emotional training strategy that would reduce stress and enhance the clinical performance of nurses during clinical crisis events. Subsumed under this would be the following: (1) to explore the strategies that have already been used to train nurses and other healthcare professionals in managing stress/anxiety in high-acuity clinical events; (2) to determine the effectiveness of the strategies that have been used; (3) to evaluate the effect of added simulation realism through the use of SPs on students' stress and clinical performance; and (4) to implement and evaluate the effectiveness of the developed emotional training strategy in reducing stress and enhancing performance.

RESEARCH QUESTIONS

To address the aims of the thesis, the overarching research question was: what is the place of emotional training strategy in simulation-based learning of acute situations? From this the following research questions were proposed:

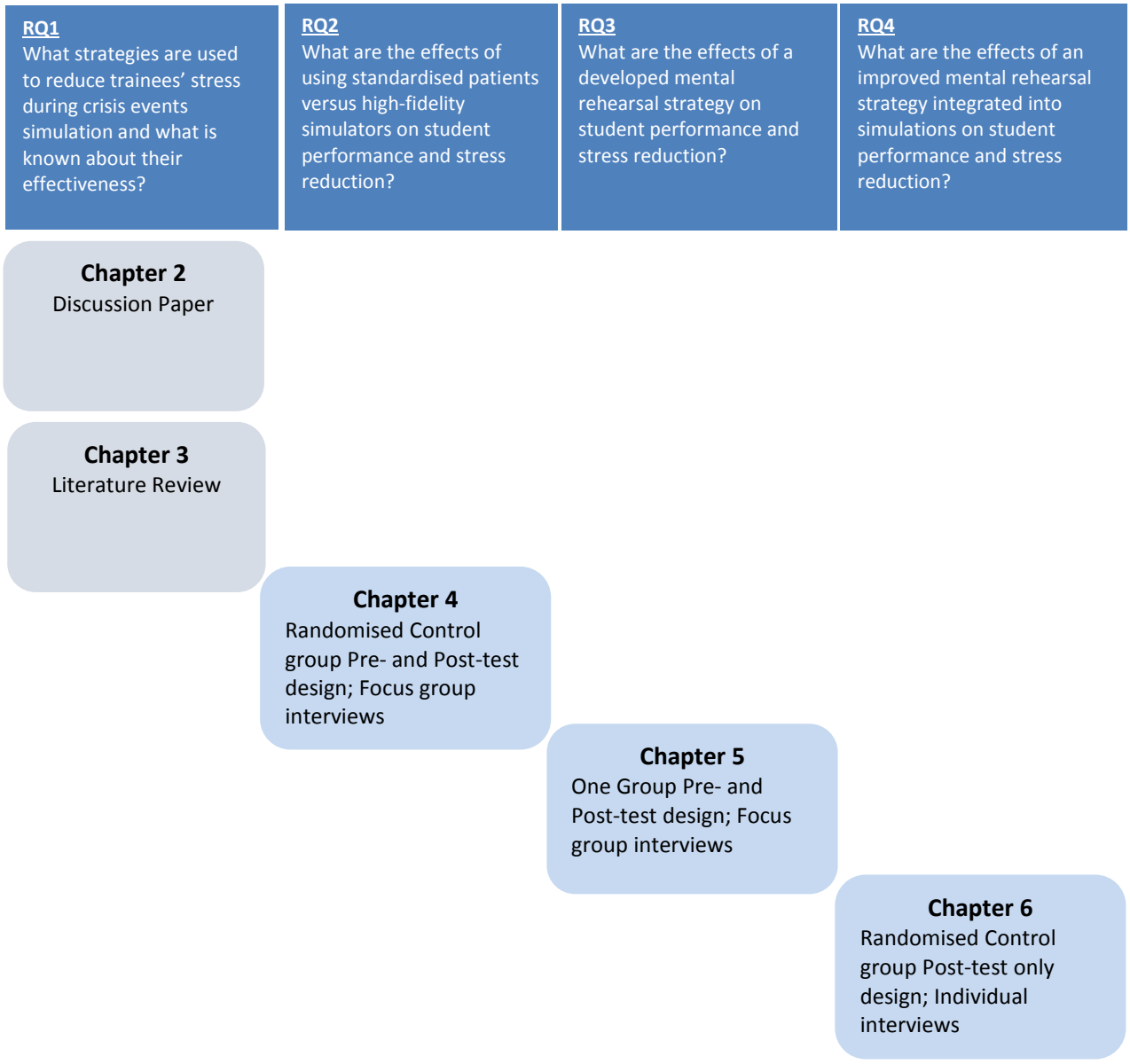
1. What strategies are used to reduce trainees' stress during crisis event simulations and what is known about their effectiveness?

2. What are the effects of using standardised patients versus high-fidelity simulators on student performance and stress reduction?

3. What are the effects of a developed mental rehearsal strategy on student performance and stress reduction?

4. What are the effects of an improved mental rehearsal strategy integrated into simulations on student performance and stress reduction?

Figure 2. Overview of chapters and related research questions



RESEARCH CONTEXT AND SETTINGS

The sequence of research studies that comprise this thesis was implemented in year 3 undergraduate (final year) nursing students who were enrolled in the Clinical Decision-Making module and the Transition-to-Practice module at the Alice Lee Centre for Nursing Studies, Yong Loo Lin School of Medicine, National University of Singapore and were implemented from August 2012 to May 2015. The participants for each phase were recruited from the final year cohort during the time each phase was conducted. Hence three cohorts of final year nursing students were involved in the course of three years. For each cohort, the study was conducted while the students were enrolled in the Clinical Decision-Making module and subsequently, in the Transition-to-Practice module.

The Clinical Decision-Making module is a one-semester final year nursing module that primarily utilizes simulations to help students consolidate what they have learned from year 1 to year 2, and prepares them for actual clinical practice. It enables them to integrate and apply their knowledge from anatomy, physiology, pathophysiology, pharmacology, and medical and surgical nursing to care for patients in acute critical conditions, such as clinical deterioration. During simulations with high-fidelity simulators, students are taught to assess and manage the "patient" by using the airway, breathing, circulation, disability, expose (ABCDE) mnemonic. Assessment of clinical performance is done using the Rescuing A Patient In Deteriorating Situations (RAPIDS) tool which has been demonstrated to be a valid and reliable outcome measure (Liaw, Scherpbier, Kalinin-Yobas and

Rethans, 2011). This tool was designed to evaluate performance in patient deterioration situations. On the other hand, the Transition-to-Practice module similarly runs for one semester and is also for final year nursing students in the second semester. This module aims to help nursing students amalgamate theory and clinical knowledge through actual experience in a hospital setting during a nine-week clinical placement. Hence, this module provides students hands-on experience on the roles and functions of registered nurses. This is to prepare them for their work as staff nurses post-graduation. The Clinical Decision-Making module is, thus, an excellent platform wherein the intervention developed in this thesis could be tested. As the developed strategy links closely with clinical practice, the Transition-to-Practice module is also an avenue where the developed intervention or strategy could be used by the participants and subsequently tested for its applicability in actual clinical settings.

The Centre for Healthcare Simulation (CHS) of the Yong Loo Lin School of Medicine, National University of Singapore is equipped with an up-to-date simulation facility that mimics the actual hospital setting. The patient deterioration simulations that were conducted all throughout this project were done in the simulation centre's general ward setting. The ward is equipped with a high-fidelity simulator, the 3G SimMan®, which is used in patient deterioration scenarios for the Clinical Decision-Making module. This mannequin has also been used in this project. Knowledgeable simulation technologists assisted in the running of all the patient deterioration simulation scenarios. Additionally, the CHS' established Standardised Patient (SP) Programme was also one resource that was fully utilised in this

project. The SPs trained by experienced SP educators provided the realism needed in the development of the emotional training strategy, the mental rehearsal strategy in simulation (Anderson, Holmes, LeFlore, Nelson & Jenkins, 2010).

Well-crafted simulation scenarios were conceptualised in consultation with experts on patient deterioration and the Clinical Decision-Making teaching team. These scenarios allowed for the measurement of the participants' performance and stress levels in every phase of the project that led to the mental rehearsal strategy in simulation.

OVERVIEW OF THE CHAPTERS

Chapter 2 gives an overview of the relationship between emotional responses, particularly stress, and performance, and reviews some of the strategies that could be integrated into the nursing curriculum to facilitate emotional and skills training. Chapter 3 is a review of literature which explores the strategies that were being used by nurse trainees or other health professions trainees to manage stress and anxiety during simulation training. It also looks at the effectiveness of the strategies that were used. Chapter 4, meanwhile, involves a mixed methods study comparing the effectiveness of using standardised patients (SPs) with high-fidelity simulators in reducing stress and improving clinical performance in deteriorating patient simulations. Chapter 5 describes the development, implementation, and evaluation of a mental rehearsal (MR) strategy that could be integrated into simulation to improve nursing students' clinical performance and to reduce stress during critical clinical events. Chapter 6 details a mixed

methods study that compares the MR strategy in simulation and the use mnemonic in improving the participants' performance scores and in reducing their stress levels during deteriorating patient simulations. Chapter 7 is a general discussion of the whole project, specifically highlighting the learnings from undertaking the series of studies that led to the development of the MR strategy in simulation. It also focuses on the implications of the study results to health professions' education and research. Finally, Chapter 8 gives a concise summary for each of the thesis chapters.

Some overlap within the chapters may be inevitable as all the chapters have been submitted for peer review or published as individual papers.

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CHAPTER 2

Emotional Training and Simulation in Nursing Education: Stress and Anxiety Management Strategies

Under Review

INTRODUCTION

In the clinical setting, healthcare professionals' emotional responses such as anxiety and stress have great impact on their clinical performance (Melincavage 2011; Müller et al 2009; Piquette Reeves & LeBlanc 2009). The relationship of stress and emotions has previously been elucidated by Lazarus who emphasized on their interdependent nature (Lazarus 1999). Resuscitation scenarios, for instance, trigger a significant amount of stress which necessitates that clinicians involved – both doctors and nurses – be trained, not only in clinical skills, but as well as in non-technical skills that facilitate patient safety (Noris & Lockey 2012). Clinical encounters with severely ill and deteriorating patients also elicit stress in the healthcare team (Liaw, Chan, Scherpbier, Rethans and Pua, 2012). Hence, literature have pointed out the need to utilise a potential stress-reducing strategy that provides emotional training in a high-acuity clinical event (Harvey et al 2010; Liaw et al 2012).

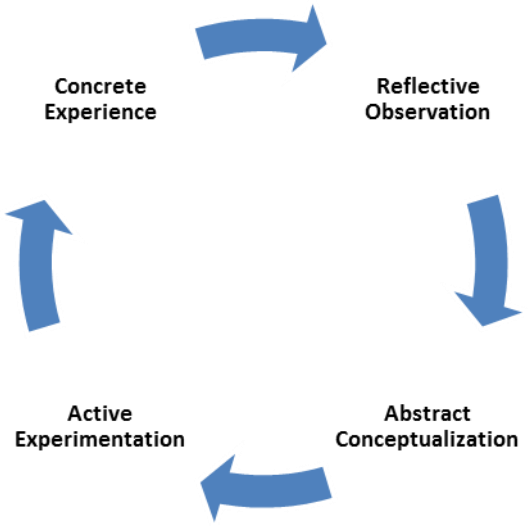
Stress is common in the clinical setting and can contribute to poor performance from lack of focus and inefficiency (Larkin et al. 2010) that lead to errors. Because of this, it was suggested that for healthcare professionals to manage stress better, educational institutions should be involved by incorporating emotional management into their training programmes (Müller et al. 2009). LeBlanc (2009) emphasised the need for technological and educational strategies to avoid the negative impact of stress on performance. In nursing education, some studies have explored the use of simulation in

training students to deal with stressful clinical events (Carver & O'Malley 2015; Gantt 2013). It is anticipated that the degree of realism of simulation training results in similar learner emotional responses (Flanagan, Nestel and Joseph, 2004). As such, a simulation experience that has psychological fidelity can train learners to better manage stress when they encounter the same situations in actual practice (Müller et al. 2009). Students also become better equipped to perform under stressful situations when they engage in overlearning training, that is, frequent practice that encourage mastery of skills (LeBlanc 2009; Liaw, et al., 2012). The reduction in stress may come as result of a critical appraisal of demands derived from emotional engagement in a simulated experience. An immersive learning platform, therefore, that replicates the actual clinical milieu and allows student nurses to have some degree of emotional involvement is beneficial. It will provide student nurses with an authentic clinical experience which will facilitate learning as these students touch base with having concrete experience, doing reflective observation, developing abstract conceptualization, and finally, actively experimenting by applying the concepts in new situations (Kolb, 1984). To date, there is a paucity of strategies integrated in existing nursing simulation programs that aim to train affective skills relating to stress and anxiety management. This chapter will expound on how the experiential learning theory can be used as the underpinning framework for such strategies, and will briefly elucidate on the effects of stress and/or anxiety and clinical performance. It will also explore and describe the various strategies that can be feasibly used and integrated into simulation trainings to reduce emotional responses such as stress and anxiety.

EXPERIENTIAL LEARNING AND EMOTIONAL RESPONSES

Kolb's (1984) model of experiential learning can be aptly utilized as an underpinning framework of potential strategies for emotional training. In Kolb's model, experience is emphasized as having an important role in the learning process. Central to the acquisition of knowledge is the process of "grasping and transforming experience" (Kolb, 1984, p.41). These processes are aptly portrayed by four stages in a cycle namely, concrete experience, abstract conceptualization, reflective observation, and active experimentation (Figure 1). Learners go through each stage of the cycle at any given time but all four are necessary to achieve effective learning. Experiential learning is based on two continuums – processing continuum (reflective observation and active experimentation) and perception continuum (concrete experience and abstract conceptualization). The processing continuum involves processes relating to task approach whereas the perception continuum involves emotional responses such as learning by sensation or by thinking. In experiential learning, adaptation takes place such that ideas are formed and re-formed through experience (Kolb, 1984). Simulation activities thus are appropriate strategies to provide students with the opportunity to learn through experience.

Fig 1: Kolb's Experiential Learning Cycle



Emotions are inevitably linked to all clinical situations. However, the emotional component of scenarios in the hospital setting has not received much focus. It has been reported that the emotional condition and the intellectual capacity of an individual are of similar importance when making decisions (Appelbaum, 1998) thus, emotional learning or training is intrinsic for nurses to be able to master various clinical situations, particularly those that involve emotional encounters that may affect performance. The challenge, therefore, of educational institutions is to train nurses in a way that allows for realism in hands-on training, focusing, not only the physical fidelity of the strategies, but as well as the psychological aspects such as emotions, that may affect actual clinical performance, particularly in crisis event scenarios. Experiential learning is based on the concept that if individuals

experience something by doing it, they are likely to initiate action. By engaging in exercises that are directed at experiential learning, students are able to integrate the cognitive, emotional and physical components of learning to create meaning and to synthesize information (Kolb, 1984).

Kolb's experiential learning framework, thus, can be utilized to integrate emotional training into simulation-based education. This is to address the need to have a training program for student nurses so they can be better equipped in responding to emotionally challenging or stressful situations, such as crisis events. This is to not compromise their clinical performance. As there is a dearth of research in this area, particularly in nursing literature, a further investigation of the feasibility and possible merits of integrating emotional training into crisis events simulations, such as patient deterioration, is warranted. By so doing, the negative impact of emotional responses, such as excessive stress, on clinical performance will be minimized. The end results will be better patient outcomes and enhanced quality of care.

The multitude of exposures to emotionally-loaded clinical events triggers corresponding emotional reactions from the healthcare staff, primarily nurses who are usually the first ward responders. These clinical events clearly need to be recognized and managed to be able to provide efficient and safe care to patients, especially in clinical crisis scenarios. Because emotions are a critical component of all high-acuity clinical-based encounters, student nurses need to be trained, not only in performing skills, but also in emotional learning. Hence, the need for emotional training strategies to be integrated into the nursing

education curriculum. Experiential learning has been described as a "holistic process of adaptation to the world" (Kolb, 1984, p.31); it takes into account the thinking, feeling, and perceiving of an individual (Kolb, 1984). Because of this holistic context of experiential learning, it can provide a sound framework for emotional learning to take place. Student nurses should thus be trained in a manner that develops their technical and non-technical skills, with emotions being integral to the latter.

EMOTIONAL RESPONSES AND CLINICAL PERFORMANCE

The effects of stress on clinical performance have been noted by some studies (Arora, et al., 2010; LeBlanc, 2009; McDougall et al. 2013; Weinberg and Creed, 2000) and managing stress has also been identified as one type of human factor essential to provide competent and safe clinical practice (Norris and Lockey, 2012). Whether stress detrimentally affects performance, as some studies have shown (Arora et al. 2010; LeBlanc et al. 2012) or whether it serves to enhance performance at the right amounts (DeMaria et al. 2010), a better understanding of how it could be addressed and managed to facilitate learning is needed. Indeed, the impact of stress on clinical performance should not be downplayed. Negative effects of excessive stress in the clinical setting can pose remarkable effects on healthcare professionals, primarily nurses who are in the frontlines. These negative effects have the potential to affect their ability to analyze clinical situations, to make decisions and to perform certain clinical procedures (LeBlanc, 2009). Stress threatens the individual and involves both emotional and physiologic responses initiated by the

"stressor" (de Veld, Riksen-Walraven and de Weerth, 2012). Stress is defined as "a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being" (Lazarus and Folkman 1984, p.19). Differences in cognitive appraisals of the varying stresses that individuals experience from the world around him/her result in varying responses to stress, that sometimes, may necessitate the need to cope. Coping, as defined by Lazarus and Folkman (1984), is "constantly changing cognitive and behavioural efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person" (p.141). Emotion-focused coping is a function of coping geared towards the regulation of the emotional stress (Lazarus, 1999). As coping is a process that involves appraisals and re-appraisals, it is dynamic. Changes in an individual's coping, thus, cannot easily be described by static and direct measures of general characteristics (Lazarus & Folkman, 1984). The ability to regulate emotional stress is a demonstration of being able to cope, and is integral to the holistic adaptation inherent in experiential learning. All stressful events elicit some degree of coping, and changes in coping may occur quickly in a matter of minutes or hours, or may occur over extended periods of time such as in weeks or months (Lazarus & Folkman, 1984). The transformation of experience facilitated by the simulation learning encounters that elicit the coping process, quickly or gradually over extended periods, facilitates adaptation. Adaptation outcomes, therefore, are affected by the coping process (Lazarus & Folkman, 1984).

The experiential learning theory espouses that individuals learn by doing and that "learning transforms experience in both its objective and subjective forms" (Kolb, 1984, p.38). Thus based on the application of this educational theory in nursing and healthcare education, immersive learning activities that allow experiential learning may improve clinical performance. And as some studies have shown that stress can affect individual performance (Arora, et al., 2010; Le Blanc, 2009; Müller, et al., 2009), it is worthwhile to consider interventions that will empower nurses to cope with and manage stress associated with crisis events. It is all the more beneficial if these interventions will be incorporated early on during the nursing education or training.

STRATEGIES TO REDUCE EMOTIONAL RESPONSES: STRESS AND ANXIETY

In healthcare education, studies have explored the use of simulation to train students to deal with stressful clinical scenarios such as with deteriorating patients (Liaw, et al., 2012) and trauma cases (Harvey, et al., 2010). Liaw, et al., (2012), however, stated that albeit the skills and knowledge derived from the simulations were found by the student nurses to be valuable in the actual clinical setting, the realism was inadequate to equip them with the whole gamut of skills, both technical and non-technical, necessary to cope with highly emotional and stressful clinical experiences.

LeBlanc (2009) noted that medical educators should consider stress management techniques in their training such that the possible negative effects of stress on performance can be avoided. As nurses also experience a great amount of stress, especially during critical

clinical events, emotional training to cope with stress should be incorporated into existing nursing training programs.

Simulation in healthcare education provides students with opportunities to have beneficial hands-on experiences in managing patients in clinical situations. As the realism of a simulation experience is increased, the emotions elicited from learners also approximate those felt in actual settings (Flanagan, Nestel and Joseph, 2004). A simulation experience, therefore, that allows, not only for physical fidelity, but also psychological fidelity can train learners to better manage their emotions and cope with stress when they encounter the same situations in actual practice (Müller, et al., 2009). To make simulation sessions as close to reality as possible, and to provide authenticity to the patient encounter, the use of standardized patients (SPs) is increasingly being used. SPs have been thought of as appropriate "tools" to bring realism to a clinical scenarios (Anderson, Holmes, LeFlore, Nelson and Jenkins, 2010; Ignacio, et al., 2015). An SP is defined as "a person trained to portray a scenario, or an actual patient using his or her own history and physical exam findings" (Gliva-McConvey, 2009). SPs have already been used effectively for teaching, assessments and research (Jenkins and Schaivone, 2007). The use of SPs in nursing education is gaining momentum, and more and more nurse educators are trying to integrate SPs into their training programs (Anderson, et al., 2010). Jenkins and Schaivone (2007) have noted that the inclusion of SPs into nursing training programs enables students to be taught and evaluated on the skills needed to be competent clinicians. Furthermore, as certain simulation activities have already been shown to decrease stress and improve clinical

performance (Müller, et al., 2009), the use of SPs which has been noted to increase the realism and to provide similar psychological or emotional challenges to the learners as the actual clinical event does (Flanagan, et al., 2004) can prepare learners for stress through inoculation and also through real-life interaction with patients in stressful critical clinical conditions thus, avoiding excessive stress that can impair their performance (Ignacio, et al., 2015; Saunders, Driskell and Salas, 1996). It is postulated that training in crisis event simulations involving SPs will accentuate the reality of the scenario and create an approximate psychological fidelity of an actual high-acuity situation. Also, students become better equipped to perform under stressful situations, such as during crisis events, when they have frequent involvement in simulation exercises that encourage overlearning (LeBlanc 2009; Liaw, et al., 2012).

Mindfulness training

There are other modalities that can be used alone or incorporated into simulation for students to have holistic experiential learning which addresses the emotional aspects of clinical scenarios. One such modality or strategy is mindfulness training. This strategy can be incorporated into simulation-based education to address the emotional component of high-acuity events. It refers to the psychological concept of being aware of the present moment, and being non-judgmental of everything taking place in a particular instance (Kabat-Zinn, 2005). It has gained some reputation because of its purported efficacy as part of stress reduction programs (Irving, Dobkin & Park, 2009). In a recent study by Kilpatrick, et al. (2011),

mindfulness-based stress reduction training has been shown to increase the functional connectivity within brain networks, which translates to an enhanced processing of sensory stimuli and an increased attentional awareness. Attentional awareness gives focus to emotions and experiences, and as such, mindfulness can be a promising component of emotional training grounded on experiential learning. As mindfulness involves emotional and environmental awareness and/or meditation, it can be considered as a possible component of any emotional training strategy package. As have been shown by literature (Irving, et al., 2009), it can stand-alone as an effective intervention that addresses emotional issues such as stress and anxiety. However, it can also be combined with other modalities that enhance other emotion-linked responses such as music therapy, narratives, breathing exercises, among others, that perhaps may be integrated into a simulation-based training to regulate emotional responses, consequently enhancing clinical performance. As of date, much of the literature on mindfulness used as an intervention to reduce stress and anxiety in nurses or nurse trainees do not focus on managing acute stress in high-acuity clinical events (Chen et al. 2013; Gauthier et al. 2015; Kang, Choi and Ryu 2009; van der Riet et al. 2015; Song and Lindquist 2015), rather, mindfulness has been used to address general stress caused by various factors. It is noteworthy, however, that these studies demonstrated the positive effects of mindfulness training of nursing staff and trainees such that stress, anxiety, depression, mindful awareness and sense of well-being were all subsequently positively affected. In fact, the study by Song and Lindquist (2015) on mindfulness-based stress reduction in Korean

nursing students showed that this strategy holds much promise as an enhanced mindful awareness has the potential to be of help in the students' academic and clinical work. As a matter of fact, a brief on-site mindfulness practice has also been shown to benefit a group of pediatric ICU nurses by significantly reducing their stress levels (Gauthier et al. 2015). Hence, judging by the increasing number of literature focusing on nurses and nursing students that employ mindfulness as an intervention to reduce stress, a mindfulness-based strategy that addresses acute stress in high-acuity clinical events can be of value when integrated into students' simulation-based training programs.

Progressive muscle relaxation technique

Because anxiety is complementary to stress and these two concepts have overlapping characteristics (Bystritsky & Kronemyer, 2014), anxiety has often been taken to reflect stress. Basing on successful results of utilizing muscle relaxation exercises on individuals with anxiety, progressive muscle relaxation (PMR) techniques have also been utilized to decrease anxiety in nursing students (Ahmadnejad et al. 2011; Carver and O'Malley 2015). Recent studies have proposed that muscle relaxation works because of the sense of control that users derive from practicing it (Conrad and Roth 2007). It is, therefore, not surprising that using this strategy in a group of nursing students to reduce overall anxiety in the clinical area (Ahmadnejad et al. 2011), and to reduce acute anxiety during simulation sessions (Carver and O'Malley 2015) proved to be effective. PMR as an emotional training strategy holds much promise as it is cost-effective and easy to teach to

learners. Its integration into the nursing training, either as part of the simulation curriculum or as a stand-alone, may prove helpful to decrease anxiety – a concept that is strongly associated with stress– which can possibly negatively impact learning at excessive levels.

Mental rehearsal

Mental rehearsal involves the repeated mental visualization of the steps of a particular task to enhance performance or to practice a skill. It is an accepted strategy that has been used by athletes to improve their performance (Aoun, Batjer, Rezai & Bendok, 2011; Cocks, Moulton, Luu & Cil, 2014). It is also considered as a coping strategy that affects emotions and cognition in a positive way, mental rehearsal has resulted in an improvement of self-efficacy in athletes (Jones & Stuth 1997). One study proposed that this strategy can be considered as a form of stress inoculation that helps in decreasing stress (Arora et al. 2011). The imagery or visualization involved in mental rehearsal has been suggested to produce psychophysiologic effects as the same emotional responses as the actual performance are produced during the process (Lang et al. 1993). Mental rehearsal is also not new in the field of music as it has been used by musicians to enhance their performance with successful results (Hodges & Sebald 2011). In the healthcare field, mental rehearsal has been used primarily by surgeons to train for certain procedures, such as laparoscopic surgery, prior to engaging in simulations (Aoun, et al., 2011; Eldred-Evans, et al., 2013) and by nurse trainees to practice skills (Doheny, 1993). It has also been shown that such a method reduces stress in a sample of novice surgeons (Arora, et al., 2011), and has thus been incorporated as a vital

component of a stress management training for surgeons which has resulted in enhanced performance and diminished stress (Wetzel et al. 2011). The utilization of this strategy together with simulation training in preparing trainees for actual clinical practice can prove to be beneficial and cost-effective as it easy to do and can be done by the learner at any time he/she wishes to do so. By using this strategy, learners are empowered to use their minds to practice skills and more complex procedures, such as managing a high-acuity case or a patient in deterioration. Such learning experiences also provide nurse trainees or learners the opportunity to prepare themselves for stressful clinical events through changes in emotions and thinking which result from mental rehearsal engagement (Jones & Stuth 1997).

CONCLUSION

The clinical setting is replete with events that could trigger emotional responses from healthcare staff, particularly nurses who are most often at the patient's bedside. Stress and anxiety are usually manifested by the nurses as they deal with high-acuity or critical clinical events. The stress and/or anxiety derived from these events can negatively affect performance when present in excessive levels and as such, can result in detrimental effects on patient care. An intervention, therefore, that can be integrated into the nursing curriculum which addresses this issue is of great value.

Mindfulness training, progressive muscle relaxation, and mental rehearsal are just some of the interventions that are considered helpful

in reducing stress and anxiety in students. There are other strategies that have been used to effectively reduce general stress and anxiety (e.g., breathing exercises and stretching, among others) which may also be applicable in training nurses and other healthcare professionals to cope with stress inherent in high-acuity clinical events. The integration of strategies such as these in the curriculum, particularly in the simulation training of nursing students, can facilitate stress inoculation resulting in better performance that can translate to better patient outcomes.

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CHAPTER 3

Stress and anxiety management strategies in health professions' simulation training: a review of literature

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ABSTRACT

Introduction

Simulation training has been used to teach clinical skills to health professions trainees. Stress and/or anxiety occur in high-acuity scenarios in the clinical environment and affect clinician performance and patient outcomes. To date, strategies that have been used in conjunction with simulation training for healthcare professionals that address stress management are limited. This paper reports a literature review conducted to explore strategies used with simulations to enhance the ability of health professions trainees in reducing acute stress and/or anxiety during high-acuity clinical events.

Methods

Databases searched included Scopus, PubMed, CINAHL, Web of Knowledge and Science Direct. Literature that were chosen were those published in the English language from January 2005 to March 2015, and were peer-reviewed empirical papers that focused on the strategies addressing stress and/or anxiety during simulation training for healthcare professions trainees.

Results

Eight studies using various forms of stress/anxiety management strategies with simulations demonstrated varying degrees of effectiveness. Themes that emerged from these eight studies were excessive stress and clinical

performance in simulation, emotional training strategies in simulation, and factors contributing to stress and anxiety reduction during simulation.

Conclusions

Excessive stress and/or anxiety in the clinical setting have been shown to affect performance and could compromise patient outcomes. Health professions training curricula might benefit from a stress/anxiety reduction strategy integrated into their simulation programmes. This review showed that the stress/anxiety management strategies that have been used with simulations, mostly in surgical training, have various degrees of effectiveness.

INTRODUCTION

The symbiotic relationship between emotions and stress has been well documented.[1] It has been recognised that emotions can result in stress and, if not adequately managed, will consequently affect performance.[2, 3] Hence, in the milieu of clinical practice, a health professional's competence can be affected by emotional responses such as stress and anxiety.[4-7] Judgment mistakes may be indirect results of emotional states that cloud awareness, produce communication barriers, and produce the inability to cope with stress and fatigue,[1 8] producing human factor errors. To achieve safe practice, both technical and non-technical skills are important from the human factors' perspective.[8] Clinical performance is not just reliant on the technical skills of a clinician as effective performance was shown to be associated with emotional intelligence and decision-making skills.[9] Therefore, the link between emotions and performance cannot be denied. The need for a strategy to facilitate the integration of emotional training into clinical skills training has been highlighted in health professional education.[3]

To date, there is a paucity of strategies integrated in existing healthcare professions simulation programmes that aim to train stress and anxiety management. As much of the skills taught to healthcare professionals are mainly delivered by means of simulations, strategies that modulate stress in these realistic settings can be valuable in training. The aim of this review was to examine existing literature on the strategies that have been integrated into simulation training to reduce acute stress and/or anxiety among healthcare professionals during high-acuity clinical events. We also aimed to determine whether

these strategies resulted in a reduction of learner stress as evidenced by stress/anxiety outcome measures.

METHODS

A search of published literature from January 2005 to March 2015 was conducted on the following databases: Scopus, PubMed, CINAHL, Web of Knowledge and Science Direct. The search terms used were (stress OR anxiety OR stress management OR stress reduction) AND (simulation OR healthcare simulation) AND (performance OR skills OR clinical performance) AND (doctors OR nurses OR healthcare professionals).

The initial database search retrieved 468 publications. The titles and abstracts of these articles were reviewed. Studies that were chosen were those published in the English language and were peer-reviewed empirical papers that focused on the strategies incorporated into health professions simulation training to reduce stress and/or anxiety. These studies should have outcome measures of stress and/or anxiety taken during simulation-based trainings. Articles with strategies for stress/anxiety reduction but with outcome measures taken during simulation-based assessments were not included. Twenty-six articles qualified for full-text review. Each article was assessed independently against the inclusion criteria by a second reviewer. Appraisal of the retrieved articles' validity and relevance were appropriately guided by Young and Solomon's[10] critical appraisal questions. After an assessment of the articles based on the established inclusion criteria, only eight publications were included in the review (Supplementary Table). The reference lists of these eight papers were also assessed for

possible articles that fit the review criteria. No new articles were found. Thematic analysis was done to evaluate the identified literature.[11] The generated themes were also confirmed by the other authors to ensure the rigour of the process. The themes are excessive stress and clinical performance in simulation, emotional training strategies in simulation, and factors contributing to stress and anxiety reduction during simulation.

RESULTS

Excessive stress and clinical performance in simulation

Excessive levels of acute stress have been acknowledged as a critical factor that may adversely affect performance and compromise patient safety,[6 12-17] particularly in high-risk environments and during crisis events.[6 13] The operating theatre (OT) has been identified as one of the highly stressful areas in clinical settings,[12-14] and surgery was identified as stressful specialty area.[12-16] Management of other critical events such as resuscitations have also been shown to elicit stress responses in healthcare professionals.[6 17] All the studies included in this review recognised the presence of acute stress and/or anxiety in high-acuity scenarios and its possible negative effect on performance.[6 12-18]

The recognition of acute stress during simulated high-acuity clinical events was demonstrated by the subjective outcome measures of stress and anxiety. Self-report measures such as the State-Trait Anxiety Inventory (STAI),[12 13 15 16 18] the STAI X-1 S-Anxiety Form[14] and perceived stress using a 10-point Likert scale[17] provided data supporting stress recognition. A study by Andreatta, et al.,[14] found out that the simulator tasks evoked feelings of anxiousness and frustration as a result of the need to perform well.

Studies on the evaluation of performance and stress showed that a certain amount of stress may affect performance in simulated environments,[6 12-17] and technical skill performance was found to be inversely related to the amount of stress. Müller et al.[6] demonstrated that the participants' clinical performance was better when the crew

resource management (CRM) intervention was initiated during stressful simulator training. The study by Andreatta, et al.[14] showed that poor performance was related to "stepped-up" or increasing levels of stress as measured by increased heart rates and stress-related behaviours. In a simulated surgical crisis, a stress management intervention was actually shown to be beneficial to surgical skills performance,[13] suggesting that stress could reduce the quality of task performance in the OT setting. Similarly, other studies suggested that stress training showed an improving trend in performance and enhanced rapidity of arriving at a diagnosis.[15] [16] A stress management intervention which reduced the level of anxiety through progressive muscle relaxation was perceived by the participants as a valuable strategy for enhancing their thought process and improving their performance in communication skills.[18] In all, stress has been subjectively and objectively measured, and excessive stress has been reported to have the potential to adversely affect clinical performance. It is therefore vital to consider the integration of stress and/or anxiety management into simulation training programmes.

Emotional training strategies in simulation

In a study by Andreatta et al.,[14] a "stepped-up" sequence approach was utilised whereby pre-clinical medical students were initially trained to master their skills in simulation, followed later by the addition of a stress element (observer).The study demonstrated that by increasing the amount of stress elements, stress-related behaviours and heart rate could be increased, and these were found to be related to poor performance.[14] The introduction of a stress element with the purpose

of triggering an affective disruption was found to enable better stress management in trainees. This may imply that simulation training which addresses affective issues may help trainees to acquire stress management skills through practice.

The use of mental practice (MP) has been shown by one study as an effective strategy in decreasing stress in a sample of novice surgeons.[12] This strategy involved mental rehearsal after watching a live demonstration of a procedure together with the use of guided imagery and a procedure "script". The study showed that the effectiveness of mental experience of a task during mental practice could translate into less stress on actual skill performance, and thereby suggested mental rehearsal as a form of stress inoculation.

A combination of strategies has also proven to be beneficial in achieving stress reduction. A combined training on coping strategies, mental rehearsal, and relaxation has been shown to increase coping skills and decrease participants' stress in the intervention arm of one study.[13] In the study, participants were given knowledge on the procedural steps, instructions on surgical stress management strategies, mental rehearsal of the performance, and practice tools on stress relaxation. All recipients of the combined interventions perceived an enhancement in their surgical stress management skills after the training. Likewise, a stress training for surgical residents consisting of self-awareness, focus, relaxation, positive self-talk, visualisation and team-building has also been used with positive effects on anxiety levels and diagnostic skills.[15] In a similar study by Maher et al. on the reduction of stress in surgical residents,[16] a

combined didactic and experiential curriculum focusing on individual stressor identification, stress management strategy identification and instruction, and application of stress management strategies (e.g. relaxation, focus, visualisation and positive self-talk) was implemented. However, the study did not produce any significant stress reduction even though there was an improving trend in performance.[16]

Müller et al.[6] incorporated CRM training in simulations with the aim of training non-technical competencies to decrease stress. This training did not involve medical content and only emphasised the non-technical aspects of clinical performance. Although the intervention improved clinical performance scores and reduced stress levels, it had the same effect as the classical simulator training.[6]

A strategy that purports to increase affective realism by using high-fidelity simulation instead of low-fidelity simulation has also been used as an intervention to reduce stress in resuscitation scenarios.[17] It is known that a certain degree of stress during training can improve performance and can decrease performance-related anxiety. However, the study did not demonstrate the effective use of high-fidelity simulation over low-fidelity simulation use in terms of stress modification.[17]

A stress management strategy using progressive muscle relaxation has been shown to reduce the anxiety of nursing students in clinical simulation to prepare them for actual clinical practice in the experimental group.[18] Such a strategy was also perceived to clear

thinking and improve cognition - processes that are essential to performance.[18]

In general, review findings demonstrated that various strategies, such as mental practice, structured stress reduction, training on coping, relaxation and progressive muscle relaxation, have been used in simulation trainings to enable health professions trainees, particularly physicians and nurses, to manage stress and anxiety during clinical events.

Factors contributing to stress and anxiety reduction during simulation

The degree of simulation realism has impact on the experience of the participants as regular simulation training enhances performance during stressful conditions.[17] Furthermore, the addition of seemingly authentic stress element, such as an observer's presence, allow for stress self-management.[14] However, the use of high-fidelity simulation over low-fidelity simulation has not shown any significant difference in subjective stress measures and in salivary cortisol levels.[17] Although both high-fidelity simulation and low-fidelity simulation recreate the stress of an actual high-acuity event, neither is superior over the other.[17]

Stress and/or anxiety management, as a component of simulation training, conducted with a single intervention[12] or with a combination of strategies,[13] [15] has been shown to reduce stress. Repetitive simulation training, regardless of the type, may cause a decrease in stress as measured by physiologic markers.[6] This supports

the premise that practice and overtraining reduce stress behaviour because the more the performer is familiar with his task's requirements, the less stress affects performance.[14]

The results of a study by Müller et al.[6] suggested that a one-day simulator training course can improve performance. Another study suggested that increasing the number of simulations can have more impact on levels of stress and performance in participants.[13] Finan et al.[17] further noted that a study looking at the effects of repeated simulations, particularly focusing on resuscitation training, warrants further exploration.

Overall, factors such as realism and frequency or repetitions of the simulation-based strategy are key in designing a programme that will work in reducing stress/anxiety to a level that does not impair performance.

DISCUSSION

It is evident that strategies attempting to reduce stress and anxiety have been incorporated into some simulation programmes. Integrating stress management in health professions' simulation programmes allows for achieving optimal performance in a highly critical clinical event. This is essential because healthcare professionals are continuously involved in patient care, and may be involved in highly stressful clinical situations.

Even though the studies included in this review primarily focused on physicians, these studies provided an overview of the strategies used in simulation training to manage stress and/or anxiety

during critical clinical events, such as during surgical procedures and resuscitations. The review also looked at the merits of the strategies in terms of stress and/or anxiety reduction, and to some extent, improved clinical performance. The findings from these studies were inconclusive on the effectiveness of the strategies. However, factors such as frequency and realism of the intervention may play a role in the effectiveness of stress management strategies in simulations. The application of MP, for instance, has been shown to reduce stress in novice surgeons performing laparoscopic cholecystectomies.[12] Further investigation is needed to determine if this strategy is also effective in reducing stress during a high-acuity event. MP benefit to expert clinicians must also be further evaluated. This is because the more experienced a clinician is on a skill, the less adversely stress affects his/her performance.[12 14]

The obvious necessity to train both skills and emotions during simulation training has some basis. In 2009, LeBlanc noted that an increase in stress can impact performance.[2] As such, it was suggested that health professionals should be taught stress management.[2] Simulation is an ideal environment where stress management should be practiced as it provides a safe environment for learners to practice skills.[19] As a training methodology, it also preconditions learners such that they can manage in actual clinical settings.[20] It is, however, noteworthy to highlight that simulation can also be a mode of assessment. Variations of simulation that have been used to assess learners, such as those incorporated in Objective Structured Clinical Examinations, have been reported as stressful and anxiety-provoking.[21 22] Hence, stress generated by the simulation experience

during training which prepares learners for actual practice differs from the stress inherent in assessments or examinations that use simulation.[23] Unlike in simulation training where the goal is to inoculate learners to the stress of an actual environment to perform better, simulations used in assessments are fundamentally stressful as how well or how bad learners' perform is linked to their aspirations to progress or move up to the next level.[24]

The data generated from the eight studies that used strategies in simulation training point to the growing awareness of stress and anxiety as possible predictors of performance and, ultimately, of patient outcomes. This observation is in agreement with evidence found in other literature acknowledging that stress and anxiety affect clinical performance.[2 4 5 25] At the right amounts, stress can be a positive motivator, but at excessive amounts, stress can negatively impact performance.[26 27 28]

Strategies for stress and anxiety management

Various strategies to reduce the stress and anxiety of participants in a simulation setting were used in eight of the studies included in the review.[6 12-18] "Stepped-up" sequencing[14] supports that stress inoculation has the benefit of reducing anxiety and improving performance during stressful events.[29] Despite the premise that increasing fidelity is an important instructional design principle to enhance the transfer of simulation learning in actual clinical situations,[6] increased fidelity by high-fidelity simulation utilisation[17] may not necessarily make a significant difference on trainees' stress levels. Kneebone[30], however, suggested that addressing emotion-

related issues, such as stress associated with actual clinical practice, can make simulation training more effective. Hence, as added realism promotes the authenticity of a scenario, a more realistic intervention is expected to produce a more realistic amount of stress and thereby enable the trainees to better manage actual stress when they experience it.

CRM focusing on non-technical components during simulation debriefing has also been shown to modulate stress.[6] This finding is consistent with the aims of CRM training which is meant to reduce human error.[31] MP has also been shown to be effective in reducing stress and anxiety as shown by Arora et al.[12] Although MP has been traditionally used to enhance performance, the confidence gained associated with improved performance may contribute to the decrease in stress and anxiety.[32] A combination of strategies to reduce stress and/or anxiety for improved performance may have equivocal results. One stress management training package for surgeons proved to be beneficial as it tried to utilise coping techniques and a relaxation strategy to decrease stress and anxiety, combined with mental rehearsal to enhance performance.[13] On the other hand, another combined-intervention study that utilised a didactic and experiential curriculum involving an educational component, relaxation, focus, visualisation and positive self-talk on surgical residents did not result in any change in anxiety and stress levels.[16] A similar study using self-awareness, focus, relaxation, positive self-talk, visualisation and team building has shown to result in a decreasing trend for anxiety.[15] Meanwhile, progressive muscle relaxation showed promise as a stress and/or anxiety reduction strategy when used in a group of nursing

students in simulation.[18] This finding is in agreement with other study results that show a reduction in anxiety after progressive muscle relaxation intervention in different patient populations.[33 34] Further studies are needed to look into the effectiveness of these strategies.

There are several factors that need consideration when designing simulation programmes that include both physical and affective components of training. The studies included in the review showed that factors including degree of realism of the simulation,[17] trainees' years of experience,[12 14] number of interventions and types of exposure,[6 13 15 16] and even the number of stressors incorporated into the simulation training[14] can contribute to the effectiveness of the strategy, either positively or negatively. It is therefore vital for these factors to be considered when designing a stress and anxiety management strategy that aims to help health professions trainees to better manage stress associated with critical clinical events.

Application to health professions education

Most of the studies included in the review looked at stress management strategies incorporated in simulations involving physicians. However, in the actual clinical setting, experience of these emotion-related concepts is not restricted to medical professionals. Often, critical clinical events involving stress and anxiety also affect nurses.[3] Simulation provides a conducive setting to practice clinical skills and to engage participants such that similar emotional responses are elicited.[35] Hence, a simulation programme that incorporates skills teaching and stress management can be considered as a valuable component of health professions education.

Stress and/or anxiety management strategies would be of benefit to health professions trainees to better handle stress and anxiety during clinical practice. These strategies could be implemented as a part of simulations with variable complexity, spread throughout the course of health professions education. Strategies such as relaxation techniques, mental practice and increased realism of simulations can be gradually built into relevant modules in the curriculum. This integration will enable trainees to not only improve on their skills, but also to enhance stress/anxiety management abilities. Simulation training with the mentioned strategies could also be valuable for already practicing healthcare professionals as part of their continuing education. This gives them the opportunity to deliberately practice clinical skills or competencies and manage stress at the same time to be more proficient.[36] Such a move will ensure not only competence on technical skills, but also the ability to manage stress and anxiety.

CONCLUSION

Healthcare professionals, such as physicians and nurses, perform skills and make decisions that impact on patients' well-being. Stress and anxiety has been shown to affect the performance of skills not only in an actual clinical environment, but also in a simulation setting as demonstrated by the reviewed studies. It is notable that the majority of the studies included in the review involved stress management strategies in simulation training for physicians. Critical patient-related events are regularly encountered by nurses and other healthcare professionals in various forms, such as during the performance of skills on challenging patients, and in recognising critical patient events.

Although the findings from the reviewed articles were equivocal, the integration of simulations with both technical and affective components into the health professions training curriculum has the potential enhance clinical practice. However, based on the results of the review, further studies are needed on these stress management strategies in simulation. Future studies should also explore the type of strategies used for stress/anxiety management training, the use of such strategies in different healthcare professions, and the translation of these strategies to effect improved clinical performance.

Supplementary Table Summary of Appraised Studies

Author (year & country)	Sample	Aims	Data collection	Findings
Andreatta, Hillard & Krain (2010) United States	27 pre-clinical medical students	• Investigate whether adjusting the levels of surgical task difficulty, adding an observer, and an interaction between observer presence and surgical task difficulties result in stress (affective response) in learners using a laparoscopic surgical simulator for training	Mixed methods design: • Quantitative method measuring State-Trait Anxiety Inventory (STAI) X-1 S-Anxiety score, heart rate, blood pressure, and simulator performance • Qualitative method: observed behaviours & comments from participants	Stressors imposed on the learner may support the acquisition of stress-management skills. • Expression of stress-related behaviours & slightly increased heart rates during presence of evaluator and poor performance • Significant increase in heart rates and prominent stress-related behaviours when observer was present and there was difficulty in simulator task
Arora, Aggarwal, Moran, Sirrimanna, Crochet, Darzi, Kneebone & Sevdalis (2011) United Kingdom	20 novice surgeons (18 participants completed the study)	• Find out the effects of Mental Practice (MP) on surgeon stress • MP involved a validated MP training protocol that utilised imagery	Randomised controlled design; tested for significant differences technical skill, STAI, heart rate, cortisol, and Imperial Stress Assessment tool: • Participants performed 5 simulated laparoscopic cholecystectomies with the control group having 30 minutes of MP before each procedure	• There were no differences between MP and control group's baseline stress, imagery or technical ability • Subjective stress was lower for the MP group • Objective stress was decreased significantly for MP group

Carver, O'Malley (2015) USA	15 nursing students preparing for clinical practice	• Determine the effectiveness of progressive muscle relaxation in reducing anxiety of nursing students in clinical simulation	Pre- and Post-test; Experimental versus control group tested using the STAI; Open-ended questions were also given to participants	• There was no significant difference in pre-test STAI scores between the experimental group and the control group • The post-test STAI scores in the experimental group were lower than those of the control group, though not statistically significant
Goldberg, Maher, Fish, Milner, Yu, Martin & Goldberg (2014) USA	77 first- and third-year general surgical residents	• Determine the effectiveness of a stress training involving self-awareness, focus, relaxation, positive self-talk, visualization, and team-building	Prospective, blinded study; Experimental and control groups were compared using the STAI, heart rate and salivary cortisol levels to measure anxiety; Time to get the correct diagnosis and Objective Structured Assessment of Technical Skill (OSATS) accuracy were used to determine procedural efficiency	• The experimental group showed lower heart rates and lower STAI scores compared to the control group
Finan, Bismilla, Whyte, LeBlanc & McNamara (2012) Canada	16 neonatal/perinatal trainees	• Compare the effects of low-fidelity simulation versus high-fidelity simulation technology on objective and subjective measures of stress • Contrast variations in objective and subjective stress measures during simulated resuscitation • Assess the association between objective and subjective measures and resuscitation performance scores	Prospective randomised study using National Resuscitation Program team performance scoring tool, Anesthesia Non-Technical (ANTS) scoring tool, buccal cortisol & subjective stress (perceived stress, cognitive appraisal)	• There was an increase over time of salivary cortisol during the simulated experience, but there were no differences between the two groups • Subjective measures of stress were noted to vary over time, but there were still no differences between the groups • There was no difference in performance between the two groups

Maher, Milner, Cripe, Gaughan, Fish & Goldberg (2013) USA	20 first- and 6 third-year surgical residents	• Show that teaching and implementing stress management techniques results in stress reduction and improved performance	Blinded, matched, comparison group study which measured stress (using the STAI, heart rate, and stress scale) and performance using the OSATS	• Performance checklist scores were higher in the experimental group although not statistically significant. There was no change in anxiety state based on STAI scores and heart rate.
Müller, Hansel, Fichtner, Hardt, Weber, Kirschbaum, Ruder, Walcher Koch & Eich (2009) Germany	32 intensivists (29 completed the study)	• Contrast the effects of a simulator-based crew resource management curriculum and medical simulator training on stress and performance	Prospective randomised controlled design which measured salivary cortisol and amylase, ANTS, performance checklist (6 items on diagnostic skills, 13 of therapeutic actions, 4 regarding overall clinical performance)	• ANTS scores were better post-intervention; both amylase and cortisol showed significant increase in the test scenarios • Increase in amylase but not in cortisol was significantly smaller after the intervention. • No significant difference between the two groups
Wetzel, George, Hanna, Athanasiou, Black, Kneebone, Nestel & Woloshynowych (2011) United Kingdom	16 surgical residents	• To evaluate a training package for surgeons that consisted of strategies relevant to surgical stress management. Strategies included coping, mental rehearsal and relaxation	Randomised control group design using measures of stress (cortisol, coefficient of heart rate variability, STAI), performance (OSATS, Observational Teamwork Assessment for Surgery, End Product Assessment, Surgical Decision Making), and surgical coping with a qualitative component: feedback • Participants underwent stress management training consisting of knowledge, mental rehearsal, video and practice prior to the simulation. No mention of SMT duration	• Intervention group showed enhanced observational teamwork assessment for surgery performance, increased coping skills and reduced stress • Feedback showed participants perceived benefits were: improved technical skills, decision making and confidence

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CHAPTER 4

Comparison of standardized patients with high-fidelity simulators for managing stress and improving performance in clinical deterioration: A mixed methods study

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ABSTRACT

Background

The use of standardized patients in deteriorating patient simulations adds realism that can be valuable for preparing nurse trainees for stress and enhancing their performance during actual patient deterioration. Emotional engagement resulting from increased fidelity can provide additional stress for student nurses with limited exposure to real patients. To determine the presence of increased stress with the standardized patient modality, this study compared the use of standardized patients (SP) with the use of high-fidelity simulators (HFS) during deteriorating patient simulations. Performance in managing deteriorating patients was also compared. It also explored student nurses' insights on the use of standardized patients and patient simulators in deteriorating patient simulations as preparation for clinical placement.

Methods

Fifty-seven student nurses participated in a randomized controlled design study with pre- and post-tests to evaluate stress and performance in deteriorating patient simulations. Performance was assessed using the Rescuing A Patient in Deteriorating Situations (RAPIDS) rating tool. Stress was measured using salivary alpha-amylase levels. Fourteen participants who joined the randomized controlled component then participated in focus group discussions that

elicited their insights on SP use in patient deterioration simulations.

Results

Analysis of covariance (ANCOVA) results showed no significant difference, ($p = 0.744$) between the performance scores of the SP and HFS groups in managing deteriorating patients. Amylase levels were also not significantly different ($p = 0.317$) between the two groups. Stress in simulation, awareness of patient interactions, and realism were the main themes that resulted from the thematic analysis.

Conclusions

Performance and stress in deteriorating patient simulations with standardized patients did not vary from similar simulations using high-fidelity patient simulators. Data from focus group interviews, however, suggested that the use of standardized patients was perceived to be valuable in preparing students for actual patient deterioration management.

Keywords

Simulations, Stress, Performance, Patient deterioration, Nursing education

INTRODUCTION

The delivery of safe patient care is essential to achieve optimum outcomes, particularly in the management of high-acuity clinical events such as patient deterioration. It has been suggested that emotional state is as vital as intellect when it comes to decision-making (Appelbaum, 1998). Stress, which is closely tied to emotions (Lazarus 1999), involves both emotional and physiological responses to a stressor. In the classical theory of stress by Lazarus & Folkman (1984), it is defined as "a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being" (p.19). Stress is viewed as a connection between an individual and his environment, and physiological responses between individuals vary depending on the differences in cognitive appraisals of stressful events. Whether stress enhances or impairs performance depends on how a stressful stimulus is appraised (Lazarus & Folkman 1984). Appropriate levels of stress, therefore, may have some value when stressors are appraised as challenges rather than threats.

Stress, resulting in anxiety, can affect health-care professionals' clinical performance either positively or negatively in highly stressful clinical environments (LeBlanc et al. 2012; Müller et al. 2009; Melincavage 2011; Wetzel et al. 2006). A recent study by Macdougall et al. (2013) supports the view that stressful clinical events may not necessarily impair clinical performance. In this study, additional stress in simulations did not decrease students' clinical confidence or knowledge (Macdougall et al. 2013), suggesting a lack of negative

effects on performance. This is in agreement with another study that found an enhancement of advanced cardiac life support skills after addition of emotional stressors during simulation (DeMaria et al. 2010). It is vital to note, however, that these results were derived from studies conducted in simulated environments. Findings, therefore, may not be similar when investigation occurs in real clinical settings. Conversely, high cortisol levels indicative of stress has also been shown to impair performance (Arora et al. 2010; Harvey et al. 2010; LeBlanc et al. 2012). These studies involved fast-paced high-acuity simulations that caused sudden stress. Thus, cortisol increase was a response to this acute stress. Amylase, however, reacts more rapidly to a psychological stressor compared to cortisol with no carry-over effect (Takai et al. 2004). As a result of the acute nature of simulations and of patient deterioration in clinical settings, salivary amylase may be a better measure of acute stress. It is known to increase rapidly after introducing stressful stimuli as compared to cortisol (Takai et al. 2004).

Nurses play a vital role in the recognition and management of patient deterioration. As such, stressful incidents may affect their clinical performance notably when there is negative appraisal. It is therefore essential to prepare student nurses to manage emotions and stress better during training (LeBlanc 2009; Liaw et al. 2012). The emotional content of learning experiences can be addressed during simulation as this is a safe modality through which the emotional climate of a stressful clinical event can be replicated (Kneebone 2005). In high-fidelity simulations, a real-world environment is created such that learners are fully immersed in simulation. To make these

simulations interactive, high-fidelity simulators (HFS) and/or standardized patients (SPs) are utilized. Because of the resultant learner emotional engagement during high-fidelity simulation training, authentic emotional responses similar to those in the actual setting are expected (Flanagan, Nestel & Joseph 2004). It is thus postulated that by creating a simulation experience that provides not only physical fidelity, but also psychological fidelity, learners can be trained to manage stress better, resulting from the perception that stress is a challenge rather than a threat. In this case, resources are viewed as outweighing the demands, and thus can lead to enhanced performance (Lazarus & Folkman 1984; LeBlanc et al. 2012).

According to Becker et al. (2006), "standardized patients are individuals who have been carefully trained to present an illness or scenario in a standardized, unvarying manner" (p. 103). It is also postulated that the use of SPs will accentuate the reality of simulations and create an approximation of the psychological responses toward a high-acuity clinical event. Studies, however, have demonstrated that SP encounters can cause anxiety, a response associated with stress, in students (Becker et al. 2006; Robinson-Smith, Bradley & Meakim 2009). A study by Luctkar-Flude, Wison-Keates and Laroque (2012) demonstrated that perceived realism was higher when SPs were used; however, communication with ‘real’ patients was more stressful and produced higher anxiety in students. It is hence expected that SPs will increase students’ stress levels during deteriorating patient simulations. Standardized patients become added emotional stressors that enhance clinical performance. This premise is supported by a study by DeMaria et al. (2010), which found that addition of emotional

stressors in simulation increased anxiety and was correlated with enhanced performance. This is because during emotional learning experiences, such as during stressful events, the amygdala strengthens the memory for similar experiences, which brings about conscious recall (Cahill et al. 1996). The ability to recall and apply these learning experiences translates to better performance scores (DeMaria et al. 2010).

The aim of this study is twofold: to compare the effects of using SPs with using HFS on student nurses' stress levels and performance in managing patients in a simulated environment, and to explore their perspectives on these learning tools in deteriorating patient simulations as preparation for clinical placement. It was postulated that the student nurses in the SP group will experience greater stress as a result of using 'real' patients (SPs), but will have better clinical performance as compared with those in the HFS group at post-test, as evidenced by salivary alpha-amylase levels and performance tool scores, respectively.

METHODS

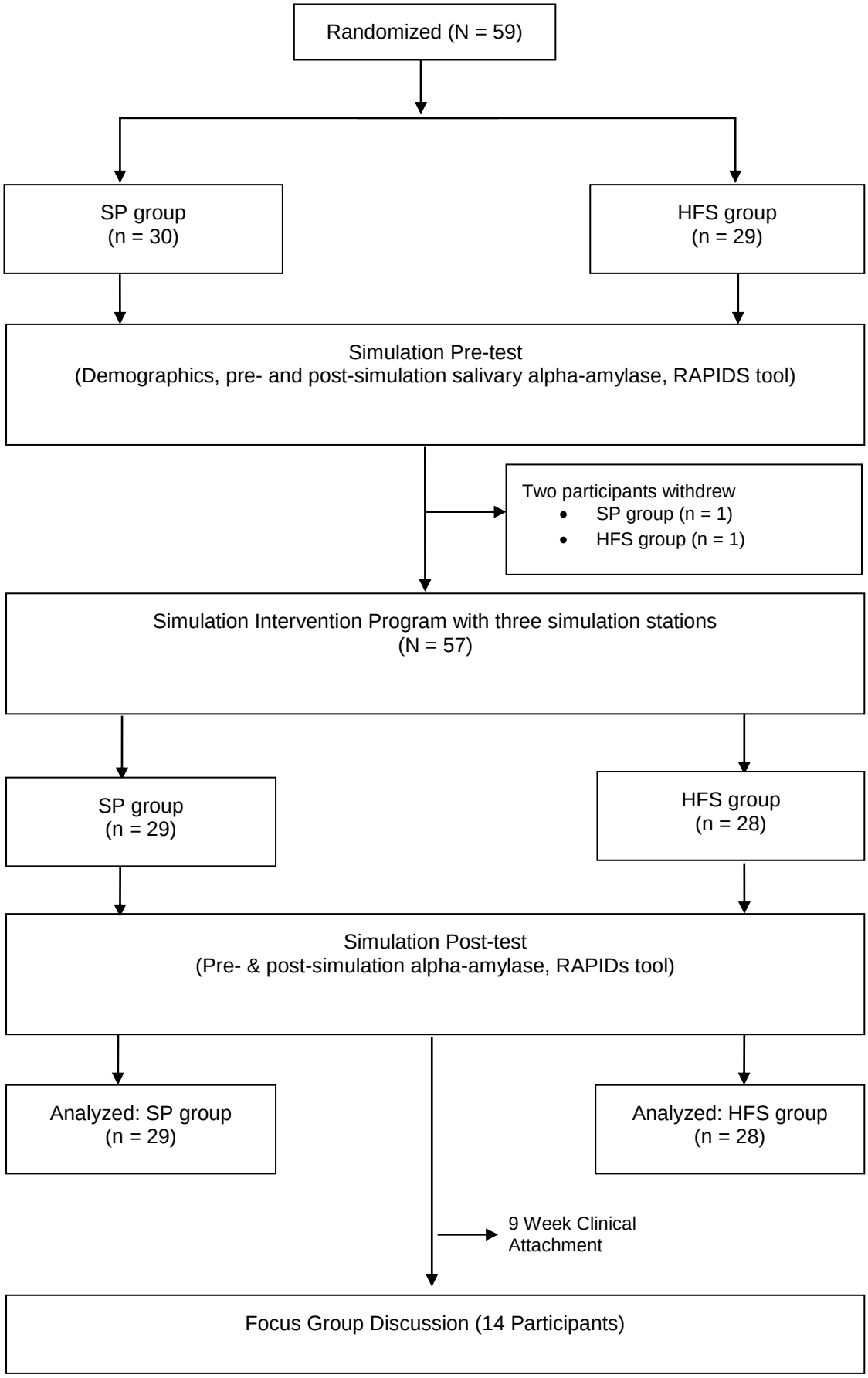
Study Design and Participants

A mixed methods which included a randomized controlled trial (RCT) with a pre- and post-test design and qualitative focus groups was conducted. The mixed methods design was deemed appropriate as the qualitative data complemented the quantitative findings (Johnson & Onwuegbuzie 2004). The RCT enabled the researchers to determine

which group had higher stress levels and higher performance scores using objective measures. The focus groups, meanwhile, provided more subjective data by exploring students' insights on the two modalities and their perceived effects on stress and performance.

Participants were recruited from a nursing department in a university in Singapore. Ethics approval was given by the university's institutional review board. All Year Three student nurses (N = 81) enrolled in the Clinical Decision-Making module and who had had no previous experience in managing deteriorating patients in clinical settings were invited to participate. Fifty-nine students volunteered and gave written consent to participate. Participants were assured that they can withdraw from the study at any time if they feel that there is potential harm to their well-being or if they are uncomfortable with continuing in their involvement. Using a computer-based random number generator, the participants were randomly assigned to either the SP group (n = 30) or to the HFS group (n = 29). Two students withdrew after the pre-test. Only 57 students completed the post-test, with 29 participants in the SP group and 28 participants in the HFS group. In the qualitative study, the 57 students who completed the post-test were invited to participate in focus group discussions after a nine-week clinical placement. Fourteen students agreed to participate. The study's flow diagram is presented in Figure 1.

Figure 1: Flow diagram of the study



Simulation Program

The study was implemented as part of the simulation program of the Clinical Decision-Making module. All Year Three student nurses were required to participate in multiple deteriorating patient simulations. After a pre-test simulation on performance, the participants went through a simulation intervention program that used either SP (SP group) or the SimMan® 3G HFS (HFS group). All the participants went through three deteriorating patient simulations using either of these modalities. As the three scenarios ran concurrently for both groups, the order of the scenarios was randomized for the participants. All scenarios, including patient parameters and SP or SimMan® 3G responses/scripts used for the two groups were identical, so that the degree of stress were the same for both groups. The only variable that could possibly affect stress was the modality used: SP or HFS. A post-test on student performance was then conducted a week later for all the participants. The deteriorating patient scenarios used in the simulations are presented in Table 1.

Table 1

Deteriorating patient case scenarios

	Patient profile	Initial presenting problem	Co-morbid illnesses	Diagnosis
Pre-Test	B.K. Lee, 59 year-old female	Moderately confused; High blood glucose	Hypertension, Diabetes Mellitus Type 2, COPD	Post-surgery (IM Nailing, Tibia, Left)
Intervention 1	R. Loh, 59 year-old female	Giddiness and feeling weak; Low blood pressure	Hypertension, Ischemic Heart Disease, Pancreatic Cancer	Post-Whipple's Procedure
Intervention 2	M. Wong, 59 year-old female	Breathlessness; Low SpO_2	Hypertension, COPD, Diabetes Mellitus Type 2	Post-Transient Ischemic Attack
Intervention 3	J. Lee, 59 year-old female	Chest pain; Tachycardia	Hypertension, Diabetes Mellitus Type 2	Post-surgery (IM Nailing, Tibia, Left)
Post-Test	B.K. Lee, 59 year-old female	Drowsy, deteriorating level of consciousness; Low blood pressure	Hypertension, Diabetes Mellitus Type 2, COPD, Ischemic Heart Disease	Total Knee Replacement, Right

Legend: COPD – Chronic Obstructive Pulmonary Disease
IM Nailing – Intramedullary Nailing

SP and HFS Preparation

For the pre- and post-test simulations, two different deteriorating patient simulation scenarios were used. These engaged four SPs, all Chinese females aged between 55 to 60 years old. The SPs were used for the pre- and post-tests to approximate actual interaction with real patients. To ensure reliability, the same SPs were used for the pre- and

post-test scenarios. The intervention simulation program, on the other hand, involved six SPs. All of them were Chinese females, 50 to 60 years old. The SPs utilized in the study had been trained by an experienced SP educator for two hours on portraying their roles. For standardization purposes, the SPs were given a script and trained in providing standard responses to students during the simulations. During the simulations, they were attached to monitors reflecting deteriorating patient parameters. To establish role accuracy, the SPs were required to go through their role-plays with simulation facilitators and scenario developers who had had extensive experience with deteriorating patient simulations.

The SimMan® 3G HFS was used in the intervention and was operated by fully trained simulation technologists and a faculty expert in simulation learning. HFS interaction with the student was established with the faculty voicing over standardized responses based on scripts identical to those provided to the SPs. Except for the use of either SP or HFS, the scenario, patient condition and parameters, the script and patient responses were identical for the SP and the HFS groups.

Outcome Measures

To assess the students' performance, the Rescuing A Patient In Deteriorating Situations (RAPIDS) rating tool was used in the pre- and post-tests. The RAPIDS is a 42-item tool with good construct validity ($t = 15.48$, $p < 0.0001$) and inter-rater reliability (ICC = 0.99) established in the local context (Liaw et al. 2011). It measures nurses' performance

in assessing, managing and reporting of patients in deteriorating situations. Two assessors, both faculty members trained to use the RAPIDS tool, assessed the participants' performance during the pre- and post-tests. The participants wore gowns and masks to blind their identities from the assessors. The assessors were also blinded to group allocation. Each participant was instructed to manage a deteriorating patient in the pre- and the post-tests. The assessors evaluated the performance behind a one-way mirror.

In the course of the study, the participants were exposed to acute stress in simulations mimicking real patient deterioration. The acute nature of these events warranted the use of salivary alpha-amylase, a biomarker for sympathetic nervous system activity (Nater & Rohleder 2009). Salivary amylase is also a better index of stress as it increases more rapidly than cortisol after presentation of psychological stressors (Takai et al. 2004). The participants' salivary alpha-amylase levels were measured before simulation, and after simulation at pre- and post-tests (Figure 1).

As alpha-amylase can be affected by food and beverages such as coffee (Nater et al. 2007), the participants were instructed to avoid heavy meals and were allowed to drink only water in the two hours before the simulation. The circadian pattern of alpha-amylase is a mirror-image of that of cortisol, having the lowest levels in the morning, and highest levels at night (Rai, Kaur & Foing 2012); thus the pre-test and the post-test, although held on different days, were scheduled at the same time of the day.

Focus Group Discussions

Upon completion of the Clinical Decision-Making module, the students had clinical placement for nine weeks. After this period, they were invited to participate in focus group interviews. This aimed to elicit their insights on how the simulations (with/without SPs) helped them in actual clinical settings, particularly when they encountered patient deterioration. Two focus group sessions, each with participants from both groups (SP = 6, HFS = 8) and facilitated by a nursing faculty experienced in conducting focus groups and who was involved in the initial part of the study, were held. As the focus group discussions were conducted during a break period prior to graduation (after the students' clinical placement), most of the participants from the randomized controlled pre- and post-test component opted not to join due to scheduling issues. Each focus group session lasted around 60 minutes. During the sessions, the participants were asked to identify whether they were from the SP or the HFS group to enable the researchers to compare their perceptions. They were queried regarding their views on deteriorating patient simulations using SPs and HFS, their actual experiences with deteriorating patients during their clinical placement, and how the use of SPs or HFS facilitated their learning and preparation for clinical placement. The questions helped to determine if multiple deteriorating patient simulations using either modality had effects on their performance and stress perceptions. The participants were probed on these areas until they no longer had further insights to give. As non-verbal cues can be useful to complement participants' verbal responses, these cues were also documented in the field notes.

Data Analysis

Descriptive statistics was used to analyze the demographic characteristics of the participants. As two assessors were involved in the evaluation of the participants' performance using the RAPIDS tool, inter-rater reliability was tested using intraclass correlation coefficient. The final score for analysis was calculated based on the average scores given by the two assessors. Percentage change value was calculated for alpha-amylase levels as these were measured at two time points each during the pre- and post-tests: before and after the participants were engaged in the pre-test and post-test simulations. Analysis of covariance (ANCOVA) was used to evaluate the effect of the intervention on post-test performance scores and on post-test amylase levels using pre-test measures as covariates. Paired t-test was used to evaluate any change from pre-test to post-test performance scores and amylase levels for each group.

For the focus group discussions, four criteria were used to ensure rigor and trustworthiness: credibility, dependability, conformability, and transferability (Streubert Speziale & Carpenter 2010). To maintain credibility, focus group discussions were audio-recorded so that the participants' responses were accurately captured. Member checking was done after each focus group by re-stating the participants' comments and questioning them for accuracy. The interview recordings were also listened to several times before transcribing them verbatim. The transcripts were then compared with the actual audio-recordings to establish accuracy. As dependability is linked to credibility, demonstration of credibility also establishes

dependability (Streubert Speziale & Carpenter 2010). Data was analyzed using thematic analysis, which involved the description and interpretation of qualitative data to find patterns of meaning and to make sense of the participants' experiences (Braun & Clarke 2006). Two researchers familiarized themselves with and immersed themselves in the data. Transcripts were read and re-read. Words or phrases that were related to the research questions were highlighted by each researcher, after which, the two researchers met and discussed to establish conformability. Highlighted information with the same meaning was categorized together. Themes from the categories were developed by both researchers independently. A final consensus on the themes was reached after another discussion between the two researchers. As all participants were graduating student nurses preparing for actual clinical work, transferability was ensured.

RESULTS

Participant Demographics

A total of 57 Year Three student nurses completed the study. The participants' ages ranged from 20 to 25 years, with a mean age of 21.74 (SD 1.078) years old. Majority of the participants were female (86%), Chinese (89.5%), and had junior college education (82.5%) prior to pursuing university education (Table 2).

Table 2
Demographic characteristics

Demographic		**Mean (SD)**	**Range**	
Age (years)		21.75 (1.078)	20–25	
		Total	**SP Group**	**HFS Group**
		N (%)	**N (%)**	**N (%)**
Gender	Male	8 (14.0)	3 (10.3)	5 (17.9)
	Female	49 (86.0)	26 (89.7)	23 (82.1)
Ethnicity	Chinese	51 (89.5)	26 (89.7)	25 (89.3)
	Malay	4 (7.0)	2 (6.9)	2 (7.1)
	Indian	1 (1.8)	1 (3.4)	0 (0.0)
	Others	1 (1.8)	0 (0.0)	1 (3.6)
Education	Polytechnic Diploma	10 (17.5)	6 (20.7)	4 (14.3)
	Junior College	47 (82.5)	23 (79.3)	24 (85.7)

Legend: *SP – Standardized Patient*
HFS – High-Fidelity Simulator

Inter-rater Reliability of Assessors

The pre-test ICC of the total RAPIDS tool scores across the two assessors was 0.906 (95% CI, 0.840–0.944). The post-test performance evaluation ICC was 0.930 (95% CI, 0.882–0.959) across the two assessors, demonstrating good inter-rater reliability.

Simulation Performance

As presented in Table 2, the ANCOVA results showed no significant difference between the SP and the HFS groups in their post-test performance scores based on the RAPIDS tool ($F = 0.108$, $p = 0.744$). There was, however, a significant increase in post-test scores from baseline in both the SP ($t = -7.017$, $p < 0.001$) and HFS ($t = -4.647$, $p < 0.001$) groups.

Table 3
Comparison of performance by groups

Outcome Measure	Groups	N	Pre-test		Post-test		Difference		Within Groups	Between Groups
			M (SD)	95% CI	M (SD)	95% CI	M (SD)	95% CI	t values	F values
RAPIDS Tool Scores	SP	29	56.07 (11.56)	51.67–60.46	69.33 (7.97)	66.30–72.36	13.26 (10.18)	9.39–17.13	−7.017***	
	HFS	28	53.91 (14.08)	48.46–72.35	67.99 (11.23)	63.64–72.35	14.08 (16.03)	7.86–20.30	−4.647***	0.108

****p value significant at < 0.001*

Legend: *SP – Standardized Patient*
HFS – High-Fidelity Simulator

Stress Levels Using Salivary Alpha Amylase

As salivary amylase was measured twice at pre-test (before and after simulation) and twice at post-test (before and after simulation), percentage change values from the pre- and the post-tests were analyzed. ANCOVA results indicated no significant difference between the SP and the HFS groups (F= 1.021, p= 0.317) as shown in Table 4. The pre-test percentage change value of the participants' salivary alpha-amylase was significantly reduced at post-test in the HFS group (t = 2.252, p = 0.033) from the pre-test value, indicating a more relaxed state at post-test. There was no significant decrease in the percentage change value of alpha-amylase in the SP group (t = 0.366, p = 0.717) from pre- to post-test, suggesting that the SP group's stress level did not change much.

Table 4
Comparison of stress by groups

Outcome Measures	Groups	N	Pre-test % change		Post-test % change		Difference		Within Groups	Between Groups
			M (SD)	95% CI	M (SD)	95% CI	M (SD)	95% CI	t values	F values
Salivary alpha-amylase levels (U/mL)	SP	29	86.66 (102.01)	47.86–125.46	75.64 (159.32)	15.04–136.24	−11.02 (162.20)	−72.72 –50.68	0.366	
	HFS	28	88.34 (114.67)	43.87–132.80	43.49 (88.50)	9.17–77.81	−44.85 (105.36)	−85.70 to −3.99	2.252*	1.021

% change values were calculated based on the following formula: (Pre-test 2nd amylase collection – Pre-test baseline)/Pre-test baseline; (Post-test 2nd amylase collection – Post-test baseline)/Post-test baseline.
**p value significant at <0.05*

Legend: *SP – Standardized Patient*
HFS – High-Fidelity Simulator

Focus Group Discussions

Six students from the SP group and eight students from the HFS group participated in the discussions. Majority of the participants were female (93%), Chinese (86%) and with junior college education (93%).

Analysis of the transcripts resulted in the identification of three themes and two subthemes for each. The themes are: stress in simulation, awareness of patient interactions, and realism. Table 5 shows the themes and the subthemes with their descriptions and verbatim quotes from the participants.

Table 5
Focus group themes and participants' comments

Themes	Subthemes	Interpretation	Examples of significant statements
Stress in simulation	Managing stress and anxiety	Participants felt that the simulation experience was stressful, and SPs added more stress to already stressful scenarios. Interestingly, even participants form the non-SP group felt that having SPs would be more stressful. Overall, the exposure to SPs in deteriorating patient situations was perceived by all the participants to be helpful in preparing them to deal with the stress and anxiety associated with stressful clinical events.	• *"SP gave us more stress, so in times of stress, we know what to do."* • *"I think the stress level in terms of clinical practice, doing with the SP would be a lot better, you would have that experience. Ok, my patient [SimMan], I don't know how it will react but if I go with SP, she reacted that way, so that maybe in the ward, the patient might react this way, so you can manage or handle anxiety level better compared to simulated ones."*
	Emotional preparedness	The stressful deterioration simulation prepared participants emotionally, especially those from the SP group, for similar events in the clinical setting. Confidence in managing patient deterioration was also perceived by the participants to be enhanced as they felt they would know what to do when they encountered similar events in the real life.	• *"So whatever you had that experience with the (standardized) patient, at that very moment you remember like emotions… it helped me to prepare myself for when I go to hospital…"* • *"I was in the SP group and then for the first few times when we practised, we always were very nervous, don't know what to do, don't know what to get. Because CDM [Clinical Decision-Making], we actually practised, a lot, a lot of times for deteriorating patients. So I kind of know what to do in the clinical setting."* • *"In the sense when SP comes in during school, it was a training opportunity with the SP. So I was able to face them with more confidence even though I was struggling inside."*

Legend: *SP – Standardized Patient(s)*
HFS – High-Fidelity Simulator

Themes	Subthemes	Interpretation	Examples of significant statements
Awareness of patient interactions	Verbal and non-verbal communication	The importance of effective patient communication during high-acuity clinical events was recognized by all the participants. It was noted that in terms of communication, the use of SPs resulted in enhancement of their communication skills, both verbal and non-verbal.	• *"The SP of course it helps more on communication part and anticipating what is unexpected."* • *"… I think standardized patient will help us, prepare for our non-verbal skill. I think we usually forget about that."* • *"I guess the advantage of a SimMan is a SimMan is merely an object… you don't feel embarrassed… when we have to talk to the SimMan, very vague response… I think the SP will be good because it allows spontaneous communication, very well reflect how we would actually respond in a real situation."*

Legend: *SP – Standardized Patient*
HFS – High-Fidelity Simulator

Themes	Subthemes	Interpretation	Examples of significant statements
Awareness of patient interactions	Understanding patients	The interaction with SPs during patient deterioration simulations allowed participants from the SP group to understand where the patients were coming from and in the process, learn to be more sensitive and aware that they were managing a person, not just a disease or a condition.	• *"So I think SP really trained me sort of multi-task because you have to, not only to handle the condition in the simulation but also handle the person you are taking care of. Not only the condition but also the person's emotion…"* • *"So when they [SPs] are in pain, they will act like a patient in pain, which can be very difficult at times to handle. So you will see (this) again in [transition-to-practice], but this time round it is real. So you will be more sensitive and you will be more aware where they are coming from."* • *"Definitely SP because living humans will give you reactions you cannot anticipate, so you have to learn to manage not only the clinical part but also how you interact with the human being as opposed to just a mannequin."*

Legend: *SP – Standardized Patient*
HFS – High-Fidelity Simulator

Themes	Subthemes	Interpretation	Examples of significant statements
Realism	Patient assessment	The participants reported that both the SP and the SimMan® 3G had limitations in terms of manifesting all the signs and symptoms of real patients. The clinical manifestations of the condition could not be assessed fully in either modality.	• *"Because for the SimMan, the lips go cyanotic… you don't know whether it's really cyanotic or blue… so something you tend to overlook… but when you have SPs you can see that they are flushed, you see that they are real."* • *"That time when you are using the lung sound, you can't really change the SPs' condition. It will be useful on your SimMan.... When there's a heart defect, then you can hear a gushing sound, the heart, the blood."* • *"I think both the SimMan and the standardized patient cannot really give you the actual representation of what a real patient would be like, but for SP, you can feel the softness of the body like the hand can do things, the physical extent as compared to SimMan."*

Legend: *SP – Standardized Patient*
HFS – High-Fidelity Simulator

Themes	Subthemes	Interpretation	Examples of significant statements
Realism	Providing experience	Lack of clinical experience of the participants meant that they appreciated the use of simulations for managing deteriorating patients. Students from both the SP and HFS groups thought the use of the SPs, however, was more realistic, hence giving them an experience closest to reality.	• *"I think I can be a bit nervous to take care of (a) patient in a bad situation for the first time, but the simulations really helped as we went through so many times like patients deteriorating although [SPs] may not be real, but somehow you will be prepared to intervene if anything happens."* • *"So, I feel that SP is better because it's more real. And the thing is that it better helps me apply into practice, when I'm in my clinical attachment."* • *"SP is the closest you get to a real thing."* • *"The SP of course helps more on [the] communication part and anticipating what is unexpected. I think for the SimMan, it helps us to practise more with our skills. Because we can do over and over again with the SimMan without having to take into account [that] the hand is already swollen or whatever…"*

Legend: *SP – Standardized Patient*
HFS – High-Fidelity Simulator

Stress in the simulation, particularly as a result of adding SPs, was perceived by the participants as helpful in preparing them to manage stress and anxiety. They have also noted that the stressful patient deterioration scenarios prepared them emotionally and increased their confidence in knowing what to do when they encountered similar events in the clinical settings. The participants also noted the importance of verbal and non-verbal communication as well as of understanding patients through having awareness of patient interactions. Realism was also a theme that came about from the participants as they acknowledged the limitation of the SP and the patient simulator in terms of patient assessment. The SP, however, was noted to provide a more authentic experience of managing clinical deterioration.

DISCUSSION

This study compared the effects on performance and stress between a high psychological fidelity SP and a HFS. Our results demonstrated that there was no significant difference in performance between the SP and HFS groups. This contradicted the assumption that better stress management from an authentic learning environment will result in better post-test performance scores in the SP group. The participants of this study could be considered novice learners in managing patient deterioration as they had had no clinical experience prior to participation in this study. As such, simultaneously performing patient-relevant skills and interacting with 'real' patients (Luctkar-Flude et al. 2012) could have posed a challenge for them, especially without repeated practice that a longer intervention period would offer. The improvement in performance, however, of both groups when the pre-test and post-test were compared, provides evidence that multiple learning modalities through simulations provide participants

with repeated exposure that prepares and aids performance (LeBlanc 2009; Liaw et al. 2011).

In the present study, the level of amylase measured from the SP and the HFS produced comparable objective outcomes on the participants' level of stress. This was contrary to the expectation that the SP group would experience significant stress with the addition of SPs (DeMaria et al. 2010). However, in our focus group discussion, the perception that having SPs was more stressful was shared by both groups. An explanation for the differing results from the objective and subjective outcomes is the possibility of salivary amylase levels not being captured at their peak as some participants took a longer time to produce sufficient amounts of saliva for analysis. According to Takai et al (2004), salivary amylase rapidly increases and wanes after exposure to stress.

The perception that having SPs was more stressful was shared by both groups during the focus groups. All the participants had no exposure to SPs prior to the research—hence their perceived stress with the modality. The relationship between objective and subjective stress measures, and performance, however, needs to be further explored as current literature show that stress determined objectively and/or subjectively may enhance or impair performance (Harvey et al. 2010; LeBlanc et al. 2012; Macdougall et al. 2013).

The significant difference between pre- and post-test amylase values demonstrated that the HFS group's stress level decreased significantly through repetitive training (Müller et al. 2009) as compared with the SP group, which had SP as an added stressor (DeMaria et al. 2010; Luctkar-Flude et al. 2012).

The premise that similar learner emotional responses are elicited during emotionally engaging simulations, such as during stressful experiences (Flanagan et al. 2004), have been shown to be important in managing stress and anxiety, and in developing emotional preparedness. It was noted during the focus group interviews that the participants felt that the deteriorating patient simulations were stressful experiences. Those from the SP group perceived that their SP simulation experience trained them to be emotionally prepared for actual patient deterioration. The participants from the HFS group, on the other hand, noted their limited emotional preparedness for such events. The opportunity to experience emotions similar to those experienced in real-life clinical situations elicited actual stress in participants during simulations. It is thus argued that emotionally engaging simulations enable learners to cope better in real-life deteriorating patient situations by emotionally preparing them and enabling them to manage actual stress and anxiety involved in similar situations in future. DeMaria et al. (2010) noted that added stressors can enhance performance. Standardized patients were considered as added stressors by the participants of the SP group. Because of this, they felt that they were better prepared to perform similar tasks in real-life settings, as they had had a more stressful experience.

A second theme that arose from the focus group discussions was awareness of patient interactions. The participants noted that they were more aware of the nuances of patient interactions, which involved communication and understanding patients, and how these influenced patient management. Those from the SP group reported that SPs facilitated their acquisition of both verbal and non-verbal communication skills, thus enhancing their confidence and communication skills during clinical events, including patient deterioration (Marken et al. 2010). The

participants of the HFS group likewise agreed that training with SPs would enable them to communicate better with real patients, particularly in stressful clinical events. All these corroborate with the assertion that SPs prepare students to interact with real deteriorating patients by giving authenticity to the experience and by promoting empathy development (Webster 2014).

Lastly, the concept of realism in terms of patient assessment and the participants' simulation experience also emerged from the focus group data. Both the use of SPs and HFS have advantages and limitations. However, frequent practice in realistic environments, such as in simulations with SPs, not only engages participants emotionally, but also enables them to adequately appraise existing resources, hence preparing them for similar cases during their actual nursing practice (Liaw et al. 2011).These realistic and repetitive simulation experiences are crucial to patient management.

Limitations

This study has limitations that warrant attention. Firstly, the participants engaged in only three simulation stations during the intervention. This shortcoming was minimized by ensuring that each patient deterioration scenario was different so that students were exposed to a variety of cases. Secondly, the metrics used to measure performance and stress might not have captured the differences between the intervention and the control groups adequately. A self-report questionnaire, together with the RAPIDS tool and the salivary amylase measures, may be beneficial. The addition of focus group discussions, nevertheless, elicited information that provided a more holistic overview of performance and stress levels. Lastly, as only 25% of the number of participants from the initial part of the study joined

the focus groups, the insights generated could have been limited. To address this issue, the researchers ensured that all the focus group sessions comprised participants from both the SP and HFS groups. The participants were encouraged to comment freely and the facilitator applied control during the focus group sessions only to keep the participants focused. Future research on the area, however, should further address these limitations.

CONCLUSIONS

In managing high-acuity clinical situations such as patient deterioration, nurses' performance can be affected by stress. It is important that simulation training be made as realistic as possible for the responses of student nurses to approximate those in actual clinical situations. The use of SPs was assumed to enhance the realism of simulations by providing psychological challenges similar to those from real-life clinical situations. It was anticipated that the student nurses would be able to practice their skills in simulation settings, and manifest stress comparable to that in real patient deterioration. In addition, with increased fidelity from the addition of SP, the students were expected to perceive stress as a challenge, and hence perform better in managing deteriorating patients.

The quantitative findings of this study demonstrated that performance and stress during management of deteriorating patients did not differ significantly with or without SPs. Based on the focus groups data, however, both groups perceived that the use of SPs in simulation training had advantages over HFS as the former mimicked real-life interactions with deteriorating patients. The participants felt that the use of SPs added more stress that prepared students emotionally to manage stress in similar real life clinical events. The use of SPs also heightened the students' awareness

of patient interactions that facilitated communication with, and understanding of, real-life patients better. Lastly, the participants also felt that more realism was gained from using SPs rather than HFS. Overall findings of this study, however, suggest that there is a need to further explore the potential advantages of using SPs in deteriorating patient simulations in terms of performance and stress. The impact on actual clinical practice also needs to be investigated.

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CHAPTER 5

Development, implementation, and evaluation of a mental rehearsal strategy to improve clinical performance and reduce stress: A mixed methods study

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ABSTRACT

Background

Mental rehearsal is a form of mental training that has been used by physicians and nurses to improve performance of clinical skills, and as a vital component of stress management training. To help novice nurses deal with often stressful clinical events that require the processing of information essential to patient management, a mental rehearsal strategy was developed and implemented in a Year 3 nursing simulation program. Inherent to mental rehearsal is imagery, which facilitates cognitive and affective modification, and reduction of extraneous cognitive load. As such, it was expected that the mental rehearsal strategy would improve students' performance and reduce stress in managing deteriorating patients.

Methods

The study used a mixed methods design. Eighteen Year 3 nursing students participated in the pre- and post-design study, which consisted of the development and implementation of a mental rehearsal strategy. The Rescuing A Patient In Deteriorating Situations (RAPIDS) tool was used to assess performance. Heart rates and systolic blood pressures were used to measure stress. The State-Trait Anxiety Inventory (STAI) was used as a psychological measure of stress/anxiety. Five participants were involved in a focus group discussion that evaluated the usefulness of the mental rehearsal strategy.

Results

There was a significant improvement in performance ($P < 0.05$).

However, post-test heart rate and systolic blood pressure were not significantly different from pre-test measures. A comparison of STAI results did not show significant differences between pre- and post-test state anxiety and pre- and post-test trait anxiety. Three themes emerged from the focus group interview: managing stress, using a mental framework and integrating realistic simulations with the mental rehearsal strategy.

Conclusion

The mental rehearsal strategy for deteriorating patient management can be valuable based on the findings on performance and based on the participants' feedback. Its role in reducing stress, however, needs further evaluation.

Keywords

Mental rehearsal, Simulation, Stress management, Nursing education, Clinical performance

INTRODUCTION

Patient deterioration is a clinical event that can elicit stress in the health-care professionals. The influence of stress on performance during such high-acuity events could affect patient management and care; hence, addressing this issue is of vital importance (Harvey et al., 2010; LeBlanc, 2009). Because of this, strategies that enable nurses to better manage their emotions and reduce excessive stress that may impair clinical performance are needed (Harvey et al., 2010; Liaw et al., 2012).

Mental rehearsal (MR) or mental practice is one strategy that holds much promise. It "refers to the cognitive rehearsal of a task in the absence of overt physical movement" (Driskell et al., 1994, p. 481). Unlike physical practice, MR is a cognitive strategy that facilitates the improvement of performance (Jones and Stuth, 1997) and involves mental training, which requires the rigorous practice of a task or a skill in the mind (Eldred-Evans et al., 2013).

Health-care research on MR showing positive results has affirmed the effectiveness of the strategy in enhancing performance (Arora et al., 2010; Doheny, 1993; Eldred-Evans et al., 2013) and reducing stress (Arora et al., 2011; Wetzel et al., 2011). The use of mental imagery in MR can be used for affective and cognitive modification to gradually eliminate negative thoughts and images that are associated with stressful events (Jones and Stuth, 1997). From the perspective of cognitive load theory, imagery—which is part and parcel of MR—results in an 'imagination effect' that facilitates acquisition of schemas in long-term memory (Leahy and Sweller, 2008). According to this theory, the use of imagery may be more vital when one is learning material that has a higher interactivity effect—that is,

material with various information that must be absorbed simultaneously (Leahy and Sweller, 2008).

The use of MR in health-care education has previously been limited to highly physical skills such as basic surgical skills, laparoscopy, venipuncture and intramuscular injection (Arora et al., 2011; Doheny, 1993; Sanders et al., 2004; Sanders et al., 2007). The effect of MR, however, in performance of a task that is more complex and involves a high interactivity element remains to be further explored. Mental rehearsal uses an integrated format— one that reduces extraneous cognitive load, and benefits learners more (Leahy and Sweller, 2004) — and thus may positively affect performance. Because the management of patient deterioration requires assimilation of multiple information presented simultaneously (e.g., interpreting vital signs, assessing signs and symptoms, etc.) and then managing the patient, an intervention that results in an 'imagination effect', such as MR, may be of value. As a stress management intervention, there is a need to explore how MR can affect stress in complex task performance. Thus, this paper aimed to determine if the developed MR strategy was effective in enhancing clinical performance and in managing stress in clinical deterioration. Given the dearth of research in the use of MR in nursing practice, this study demonstrated an innovative approach of integrating MR in nursing education and training. It showed the potential of using MR in a complex nursing task - assessing and managing patient deterioration.

METHODS

Development and Implementation of the MR Strategy

An initial literature review conducted to determine the important steps vital to initially managing deteriorating patients showed that airway, breathing and circulation were the primary foci of management. The assessment and management of patient deterioration in other institutions worldwide were also explored. Existing checklists related to patient deterioration were appraised and various visual cues needed to adequately evaluate and manage patient deterioration were examined. From this first step, a MR script specific to patient deterioration was developed, guided by the Airway, Breathing, Circulation, Disability and Examine/Expose (ABCDE) mnemonic (Liaw et al., 2011). The MR script was then sent for evaluation to local experts on patient deterioration and to the Clinical Decision-Making Teaching Team, who made suggestions on how the script could be further enhanced. After revisions were made based on elicited feedback, another round of discussions was conducted to finalize the script. The final version was then prepared and integrated into the MR strategy. The concept of mental imagery or the visualization of a skill played repeatedly in the mind without actual action (Driskell et al., 1994) is the underlying concept behind the MR strategy. The complete strategy consisted of a didactic component introducing the concepts of MR, stress and performance to participants. A video of a nurse managing a deteriorating patient was then shown to participants to help them visualize the steps involved. This was followed by a breathing exercise, a technique that promotes relaxation (Paul et al., 2007), which has been shown to lead to a substantial increase in working memory needed for cognitive tasks such as learning and reasoning (Flor et al., 2013). Finally, the MR script was

recited by a facilitator to the participants after they were instructed to close their eyes and visualize script. The details of the MR strategy for patient deterioration are shown in Figure 1. The facilitation of MR lasted 30 minutes; however, the participants were encouraged to practice the MR script on their own as many times as they could prior to the post-test later that day.

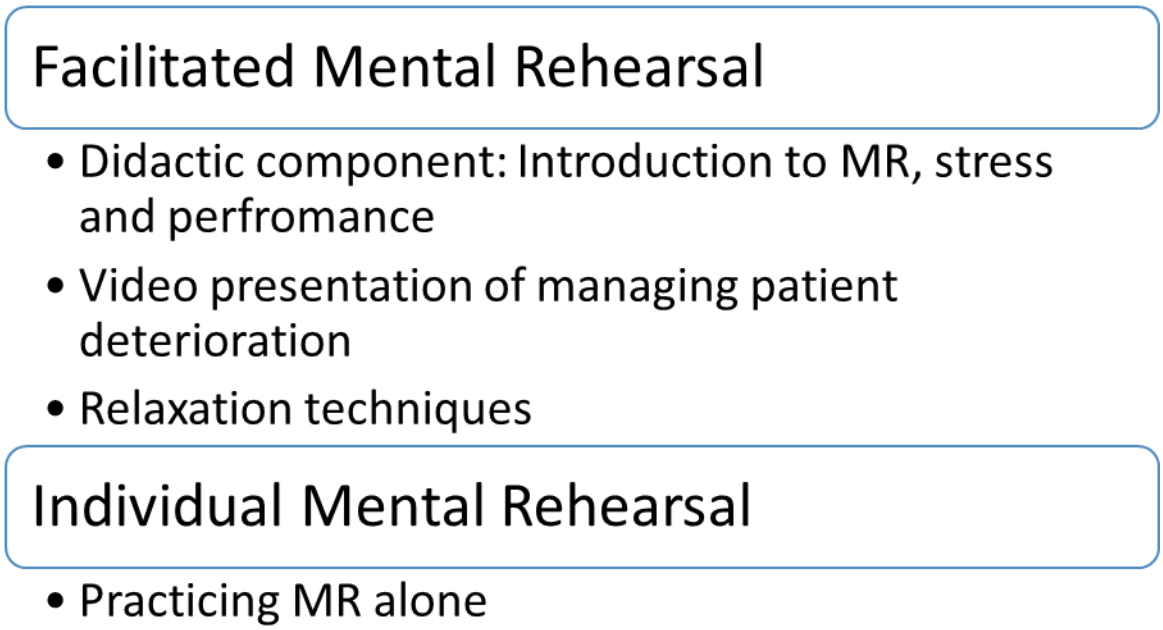

Figure 1: Mental Rehearsal Strategy

Evaluation of the MR Strategy

The study is a mixed methods design that comprised a single group pre- and post-test evaluation of the effectiveness of the developed MR strategy and a follow-up study using a focus group interview. The mixed methods design was considered appropriate as the generated information from both methods could complement one another thus mitigating the limitations of

using just one approach (Polit and Beck 2006). The combination of quantitative findings from the simulation setting and qualitative findings from the focus group after clinical exposure provided strength to the design. Ethical approval was given by the university's Institutional Review Board prior to the commencement of the study.

Study Design and Participants

One hundred and five Year 3 nursing students who had completed the Clinical Decision-Making module were invited to participate in the study. These students were in their last year of a 3-year Bachelor of Science in Nursing program. Of the total invitees, 18 students participated in the pre- and post-tests in the simulation setting. Consent was taken before the pre-test and after they were briefed on the purpose of the study, their study involvement, and the confidentiality of all information that will be taken from them during the study. A qualitative component using a 45-minute focus group discussion was later conducted for those who participated in pre- and post-tests. Of the 18 students, five participated in the focus group during which their feedback on how the MR strategy had benefited them during their clinical posting was elicited. Guide questions (Table 1) enabled the facilitator to explore the participants' experiences during their clinical attachment and how the MR strategy had benefited them. As the focus group was done after the students' nine-week clinical placement and prior to graduation, scheduling issues resulted in the low turn-out.

Table 1 Guide Questions for Focus Group Interview

Focus Group Discussions Guide Questions
1. How was your Transition-to-Practice clinical placement?
2. Did you encounter any patient deterioration during your clinical placement?
3. How did you feel during the experience and what were your thoughts then?
4. Do you think mental rehearsal is beneficial? Do you think it benefits simulation training?
5. What can be further improved such that the mental rehearsal could benefit students more? Any feedback?

Data Collection and Outcome Measures

The participants were exposed to deteriorating patient simulations at pre- and post-tests which were conducted in the simulation center. Patient deterioration simulations involved a standardized patient (SP) manifesting the signs and symptoms of a patient in clinical deterioration. In managing deteriorating patients, the participants were required to perform tasks such as pulse rate count, blood pressure taking and chest auscultation, among others. They also needed to prioritize the course of action they needed to take based on the patient's presenting clinical problems. The research was conducted at the end of Semester 1, after all the students had completed eight deteriorating patient simulations as part of the Clinical Decision-Making module. Hence, all the participants would have had the same simulation experience prior to participating in this study.

Outcome measures of performance and stress levels were used to ascertain the usefulness of the MR strategy in helping the participants manage patient deterioration. During the pre-test, demographic data such as age, gender and ethnicity were collected. Each participant was then presented with a deteriorating patient simulation. After the simulation,

baseline heart rate and blood pressure were taken; it has been shown that the activation of the sympathetic-adrenal-medullary axis (SAM) after exposure to a stressor results in the release of catecholamines that increase heart rate and blood pressure (Huang et al., 2013). As anxiety has been closely associated with stress, the State-Trait Anxiety Inventory (STAI), which has acceptable reliability and validity in research settings (Vitasari et al., 2011), was used as an outcome measure for stress. Clinical performance was assessed using the Rescuing A Patient In Deteriorating Situations (RAPIDS) tool by Liaw, Rethans, Scherpbier and Piyanee (2011). The nursing students' performance in the simulation was scored by two raters experienced in using the RAPIDS tool. Each participant wore a cap, gown and mask during the simulation so that the raters were blinded to their identities, since some of the participants might have been the raters' students previously. The MR strategy was then implemented; after which, during the post-test, the participants were again assessed on performance by the same assessors using the RAPIDS tool. Their heart rate and blood pressure were also measured after the simulation and the participants again completed the STAI (Figure 2).

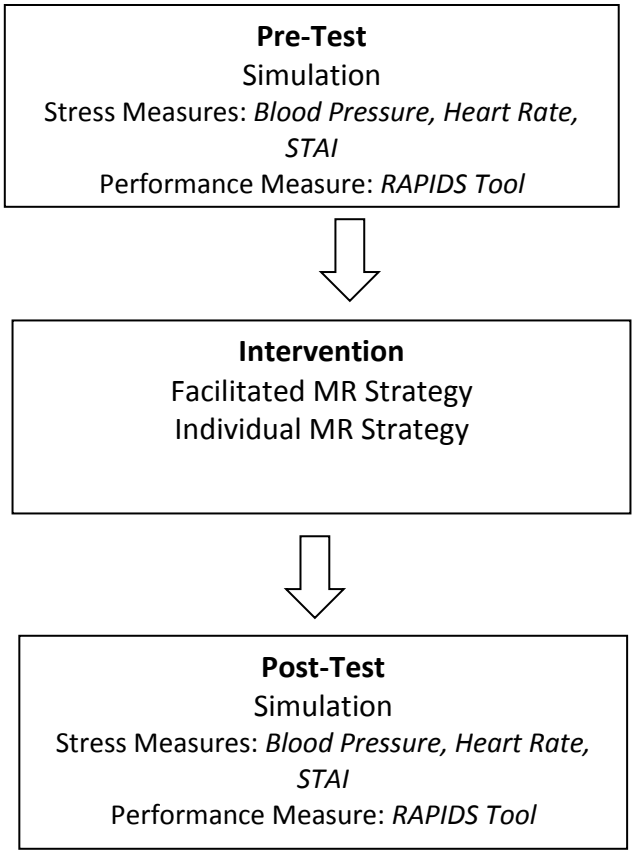

Figure 2: Data Collection & Outcome Measures

The focus group interview conducted five months after the participants had undergone the MR strategy was audio-recorded. Because the participants had already undergone a Transition-to-Practice clinical placement wherein they took on the role of staff nurses with supervision, the session enabled them to not only give their feedback on the MR strategy, but also give their views on the relevance of the strategy in clinical settings.

Data Analysis

Demographic data from the pre- and post-tests were analyzed applying descriptive statistics. Paired t-test was used to evaluate any change between pre- and post-test measures.

A thorough thematic analysis was done to find meaning from and to understand the participants' experiences (Braun and Clarke, 2006). This involved data familiarization, generation of initial codes, search for themes, review of themes, definition and naming of themes, and report-writing (Braun and Clarke, 2006). Trustworthiness and rigor were ensured based on four criteria: credibility, confirmability, dependability and transferability (Polit and Beck, 2006). Audio-recording of the focus group interviews to adequately capture the participants' views was done. Member-checking was conducted at the end of the session by summarizing the participants' comments and checking with them for accuracy. These processes were done to ensure credibility. An audit trail was kept to safeguard dependability. Familiarization with the recorded interviews was done by repeatedly listening to the audio-recordings, after which the audio-taped interviews were transcribed verbatim. Two researchers independently analyzed the scripts to find words and phrases pertinent to the aim of the research. To ensure confirmability, both researchers met to discuss the codes and group them into categories. Consensus on the themes was reached after further discussion among the researchers. Transferability was demonstrated when the researchers assessed the relevance of the findings to clinical settings based on the participants' verbatim quotes.

RESULTS

Eighteen Year 3 nursing students enrolled in the Clinical Decision-Making module participated in pre- and post- tests. Majority of the participants were female (61%), Chinese (72.2%), with an average age of 22.11 years old, and most had completed their education in junior colleges prior to attending university (64.7%). The demographic profile of the participants is presented in Table 2.

Table 2 Demographic Characteristics

Demographic		**Mean (SD)**
Age (years)		22.11 (1.079)
		Total N (%)
Gender	Male	7 (38.9%)
	Female	11 (61.1%)
		13 (72.2%)
Ethnicity	Chinese	
	Malay	3 (16.7%)
	Indian	1 (5.6%)
	Others	1 (5.6%)
		6 (33.3%)
Education	Polytechnic Diploma	
	Junior College	12 (66.7%)

Performance

A comparison of the participants' clinical performance in deteriorating patient simulations at pre- and post-tests revealed that there was a significant improvement in performance ($t = -2.52$, $P < 0.05$), which was assessed using the RAPIDS tool (Table 3). This indicates that the participants were better able to assess and manage a patient in deterioration after the MR intervention.

Table 3 Performance

Outcome Measures	N	Pre-test		Post-test		
		M (SD)	95% CI	M (SD)	95% CI	p values
RAPIDS Tool Scores	18	51.61 (12.03)	45.63–57.59	58.78 (11.83)	52.89–64.66	0.022*

**Significant at <0.05*

Stress

Post-test heart rate, as a measure of stress, did not differ significantly from pre-test values (t = 0.715, P = 0.484). Similarly, systolic blood pressure at pre- and post-test did not differ at all (t = 0.000, P = 1.000). In terms of the subjective perceptions of participant stress as reflected by anxiety, a comparison of the STAI results did not show significant differences between pre- and post-test state anxiety (t = 0.460, P = 0.652) and pre- and post-test trait anxiety (t = 0.149, P = 0.883). The results are presented in Table 4. These results suggest that the MR strategy did not produce substantial effects to change anxiety levels after the intervention.

Table 4 Stress

Outcome Measures	N	Pre-test		Post-test		
		M (SD)	95% CI	M (SD)	95% CI	p values
Systolic blood pressure	18	120.06 (12.18)	114.00–126.11	120.06 (14.91)	112.64–127.47	1.000
Heart rate		82.11 (14.16)	75.07—89.15	80.56 (12.70)	74.24—86.87	0.484
State anxiety		42.44 (10.63)	37.16—47.73	41.28 (9.89)	36.36—46.19	0.652
Trait anxiety		39.78 (7.64)	35.98—43.57	39.56 (6.76)	36.19—42.92	0.883

**Significant at <0.05*

Focus group

Five (28%) students participated in the focus group interview. Three themes were identified after the analysis of scripts, namely, managing stress, using a mental framework and integrating realistic simulations with the MR strategy.

Theme 1: Managing Stress

Some of the participants noted that their initial encounters with deteriorating patients elicited in them a sense of panic and of not knowing what to do during these stressful clinical situations. One participant said of her initial encounter with a deteriorating patient:

"I panicked when I saw the patient deteriorating. Gradually, I had a clearer idea of what I wanted to do. The initial part was more of a shock but subsequently, I became calmer and directed."

Further, because of their lack in actual clinical experience, managing clinical deterioration was deemed stressful. The use of MR enabled them to

calm down, and, as a result, to be more confident. For example, one participant mentioned:

"It is very stressful to be [a] student nurse taking your first three cases, and then suddenly, one of your patients start to deteriorate. We really need this mental rehearsal to calm ourselves down, to be assured and confident that we know what to do and that we can do it."

Theme 2: Using a mental framework

A mental model or framework has been shown to benefit students during their clinical practice. The MR script is anchored on the Airway, Breathing, Circulation, Disability and Exposure/Examine (ABCDE) mnemonic, which serves as a framework for student learning. One participant aptly described how the framework integrated into the MR helped her:

"Before you go to the ward, you know you can do certain things. However, the case might not be the one you practiced in your mind. Going through the framework actually helps you to know what you need to do."

The framework built into the MR script served as a guide to help them manage patients in deterioration. It directed their management in such a way that things get done. A participant noted:

"Having the framework guided us. It reminded us we that have to look closely at the information we already have. We could cover all the bases and this allows us to at least get work done rather than just standing around and not knowing what to do."

The participants thought that the mental imagery derived from MR was a vital step before proceeding to manage deteriorating *patients in the clinical setting. In fact, one participant mentioned:*

"I think it's important to know [mental rehearsal] so that they can paint a mental picture before going for clinical posting."

A participant summed it up succinctly:

"Having a mental picture actually helps [in managing patient deterioration]."

Theme 3: Using realistic simulations with the MR strategy

The participants reported that together with MR, the use of SPs in deteriorating patient simulations gave them a better picture of what actually happens in the wards. The authenticity that came with the use of SPs prepared them for real encounters. One student said:

"When we go to the ward, it's actually a real life patient we see, who needs our help. So with a standardized patient, although the stress is there, it's good stress that actually prepares us for the real world."

They also noted that there was a difference when simulations involved the use SPs as opposed to mannequins. They noted that with SPs, they were motivated to do their best as they were dealing with living persons. A participant thus mentioned:

"I always feel that there is a difference when we are attending [to] a situation using a standardized patient and a mannequin. Even though we know that the SP is just acting, our minds still tell us that this is very *close to a real patient, and automatically we will get into the state of doing our best."*

DISCUSSION

This study developed, implemented and evaluated a MR strategy for the assessment and management of deteriorating patients, a skill involving a more complex cognitive process resulting in decision-making. As such, the

use of MR in training nursing students to respond to patient deterioration involves the creation of a more intricate mental imagery. The findings of this study corroborate those of other studies that have shown a significant improvement in performance after MR intervention (Arora et al., 2010; Arora et al., 2011; Doheny, 1993; Eldred-Evans et al., 2013; Sanders et al., 2007). In managing deteriorating patients, the participants were required to perform tasks such as pulse rate count, taking blood pressure and chest auscultation, among others. Aside from these, they also needed to prioritize a course of action based on the patient's presenting clinical problems. The results indicate that the use of MR enhanced the participants' performance of a more complex skill, namely, assessment and management of patient deterioration. These seem to suggest that MR is effective, not only in enhancing one's performance of physical tasks, but also in tasks involving more cognitive components, such as analyzing temporal or spatial relationships and prioritizing a course of action. In fact, it has been reported that performance of a task involving more cognitive elements benefits more from MR (Driskell et al., 1994). As the MR script was presented as learning material in an organized and cohesive manner, the participants were able to assimilate information needed to assess and manage deteriorating patients, thus reducing extraneous cognitive load in the process and resulting in an 'imagination effect'; this happens when students learn more from mentally visualizing or rehearsing certain concepts or procedures (Leahy and Sweller, 2008). Because of the integration and interactivity of procedural elements to be learned—in this case, managing clinical deterioration—the acquisition of schema into long-term memory occurs, translating to better learning and enhanced performance (Leahy and Sweller, 2004; Leahy and Sweller, 2008). Thus, it is vital that the MR script be made more robust for future use by ensuring

the cohesiveness of its components so it can be better visualized in the mind. Future studies should also consider the feasibility of measuring 'imagination effect' to validate the effectiveness of the MR strategy.

An advantage of using MR to practice skills that may not be frequently encountered in clinical settings is that it can be done anytime, anywhere. It is, however, important to note that the students who participated in this study had had similar degree of exposure to deteriorating patient simulations as part of the Clinical Decision-Making module prior to this study. Thus, the MR may have supplemented the exposure they had had in the Clinical Decision-Making module to achieve improvement in performance (Sanders et al., 2004). This made it difficult to isolate the effect of the MR strategy on performance. Another possible confounder is repeated exposure; repeated exposure could lead to significant improvement in performance, regardless of the use of MR. Furthermore, the possibility that the pre-test could have had a confounding effect on performance was also considered. Future studies could perhaps avoid teaching MR after students have had multiple exposures to deteriorating patient simulations, and to exclude a pre-test on performance prior to the intervention to isolate the effect of the MR strategy on performance.

Although MR has also been shown to reduce stress (Wetzel et al., 2011), the use of MR strategy in this study did not demonstrate the same effects on stress. A probable explanation for this relates to the use of standardized patients (SPs) in the pre- and post-test simulations. The use of SPs in simulations has been shown to increase learners' anxiety (Becker et al., 2006; Robinson-Smith et al., 2009) and could explain the insignificant reduction of stress found in this study. In fact, the focus group interview

revealed that participants saw the use of SPs much more stressful than the use of mannequins in simulations.

Qualitative findings from this study, meanwhile, suggest that the MR strategy enabled the participants to manage their own stress when confronted with actual patient deterioration in the clinical setting. This is in line with a study which found MR to be a form of stress inoculation that facilitated stress reduction (Arora et al., 2011). Furthermore, the use of MR, which leverages on the ABCDE framework, was perceived by some of the participants to have a calming effect, giving them the confidence that they knew and could prioritize what to do in managing clinical deterioration. It is thus possible that the MR strategy may mitigate panic resulting from highly stressful clinical events among novices. It is interesting to note, however, that despite this perceived benefit of the MR strategy in managing stress, objective measures of stress still showed no difference pre- and post-test. As mentioned, a possible explanation for this was the use of SPs during the pre- and post-tests. Further research on this area is warranted.

The participants of this study affirmed the use of the ABCDE framework to guide the MR script: they reported that practicing the steps of managing patient deterioration using mental imagery helped them when they encountered actual patient deterioration. Instead of merely going through the ABCDE mnemonic checklist in their minds, the MR strategy allowed them to integrate information from split sources that became beneficial to them (Leahy and Sweller, 2004).

The participants thought that simulations should be a prerequisite for actual clinical practice because simulations provide opportunities for hands-on practice. The use of SPs in simulations offers the benefit of adding realism (Luctkar-Flude et al., 2012), a point supported by the findings from

the focus group interview: the participants said they were motivated to do their best in the simulations because they felt as if they were managing real patients. Unfortunately, hands-on practice in highly realistic simulations may not be cost-effective, or logistically possible all the time. Since the use of MR after initial hands-on practice has been shown to be as effective as the latter alone (Sanders et al., 2004), using MR to facilitate learning is not only valuable but cost-effective as well. The potential value of MR as an adjunct to simulation is supported in this study not only by the focus group findings, but also by performance scores showing significant improvements between pre- and post-test. Furthermore, the potential benefits of the MR strategy may be maximized when it is combined with highly realistic simulations, such as with the use of SPs.

Limitations

The strength of this study lies in the use of a mixed methods design, in which quantitative data collection was followed by qualitative data collection after the participants had had clinical exposure during which they could apply MR in the clinical setting. However, taken separately, each data collection method in this design posed some limitations. One limitation was the lack of a control group in the pre- and post-test design. While designing the study, a control group was not included because the intention was to evaluate the robustness of the MR strategy for implementation in the Clinical Decision-Making module. That said, if the performance and stress levels of students who used MR with those who used another strategy were compared, firmer conclusions about the effectiveness of the MR strategy and the generalizability of the results could have been made. Another limitation was sample size: multiple MR (facilitated and individual) sessions in a bigger sample of students could

have allowed the researchers to determine the effect of MR on performance and stress with greater confidence. Lastly, with data collected from only five participants in the focus group interview due to scheduling issues, the conclusions made about the qualitative data may not be generalizable. Future studies should address these limitations.

CONCLUSION

Patient deterioration is a stressful clinical event that Year 3 nursing students need to manage during their Transition-to-Practice clinical placement. Simulations prepare nursing students for these encounters. A MR strategy founded on the ABCDE mnemonic was developed to augment the effects of simulation in learning how to manage deteriorating patients. Implementation and evaluation of the MR strategy was shown in this study to be effective in enhancing performance. However, no effect on stress levels was found. Qualitative feedback from the study's participants was positive and supports findings from the pre- and post-tests in terms of improving their performance but not in terms of reducing stress. The feedback highlights the applicability of the MR strategy in the clinical setting.

MR is a cost-effective way of enhancing students' management of stressful clinical events such as patient deterioration. A robust MR strategy grounded on the ABCDE framework, and which integrates the various components of managing clinical deterioration, holds potential in enhancing the learning process among nursing students. Incorporating the MR strategy into realistic simulation-based training can enhance students' ability to transfer theory to practice and promote patient safety.

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CHAPTER 6

A mental rehearsal strategy for performance and stress management in clinical deterioration simulations: A mixed methods study

Jeanette Ignacio, Albert Scherpbier, Diana Dolmans, Jan-Joost Rethans, Sok Ying Liaw

Under Review

ABSTRACT

Background

A mental rehearsal strategy was developed for third year nursing students in a Clinical Decision-Making module. This strategy was expected to enhance performance and reduce stress better than the conventional approach of the Airway, Breathing, Circulation, Disability, Exposure mnemonic with mannequin simulation in regards to patient deterioration management.

Aims

The study compared the mental rehearsal strategy and the mnemonic strategy in terms of students' performance and stress levels. It also explored the benefits of using mental rehearsal in a clinical setting.

Methods

A mixed methods design was used. Thirty-two third year nursing students participated in a randomised post-test. They were randomised to either the mental rehearsal group or mnemonic group. Performance was measured using the Rescuing A Patient In Deteriorating Situations tool. Strait-Trait Anxiety Inventory, heart rate, systolic blood pressure, and skin temperature were used as stress measures. Twenty-one students participated in individual interviews after the nine-week clinical posting.

Findings

Performance between the mental rehearsal group and the mnemonic group ($p=0.105$) did not differ. The state ($p=0.524$) and trait ($p=0.516$) anxiety inventory, systolic blood pressure

(p=0.890), heart rate (p=0.692), and skin temperature (p=0.521) did not differ. Three themes were generated: being mentally and emotionally prepared, recalling and visualising the steps to be taken, and enhancing actual clinical practice.

Conclusion

The mental rehearsal and the mnemonic strategies had similar effects on performance and stress during patient deterioration management. However, the interviews suggested that mental rehearsal still benefits learning and has value health professions training.

Keywords

Nursing education, Psychological stress, Simulation training, Anxiety, Mental rehearsal, Performance

SUMMARY OF RELEVANCE

Problem

Studies that compare mental rehearsal with other strategies to improve performance and stress are lacking in patient deterioration management.

What is Already Known

Mental rehearsal has been utilised by different health disciplines as part of their training. This strategy has been shown to improve performance and reduce stress in healthcare professions trainees.

What this Paper Adds

The mental rehearsal strategy with simulations using standardised patients has been compared to a conventional strategy which suggested that neither is superior over the other. This is contrary to the qualitative evidence that suggested students perceive the mental rehearsal strategy benefits learning.

1. BACKGROUND

It is vital for healthcare professionals to deliver safe and quality care to patients. Clinical performance can be affected by factors other than the technical skills of clinicians. One of these factors is stress. Stress in a clinical setting can affect a healthcare professional's ability to analyse clinical situations, make decisions, and perform certain clinical procedures (LeBlanc, 2009). Nurses, being involved in direct patient care and the monitoring of patients, are frequently exposed to highly stressful and critical clinical events (Liaw, Scherpbier, Klainin-Yobas, & Rethans, 2011). Hence, it is important that the nursing curriculum integrates a strategy that

provides emotional training in high-acuity situations (Harvey, Nathens, Bandiera, & LeBlanc, 2010; Liaw, Chan, Scherpbier, Rethans, & Pua, 2012).

One of the techniques that has shown to be of benefit training in various fields is mental rehearsal (MR). This strategy involves repeated mental visualisations of the steps of a particular task to enhance performance (Eldred-Evans, et al., 2013). Hence, it is a cognitive strategy that involves practicing skills without any actual physical movement (Driskell, Copper, & Moran, 1994; Jones & Stuth, 1997). The value of this strategy has been recognised primarily in the area of sports wherein it has been successfully used in training athletes to enhance performance (Aoun, Batjer, Rezai, & Bendok, 2011; Cocks, Moulton, Luu, & Cil, 2014). It was also suggested that it can improve musical performances when musicians voluntarily use it prior to the actual performance (Hodges, & Sebald, 2011).

2. LITERATURE REVIEW

In the healthcare field, MR is a relatively new training strategy that has been used by a few disciplines. It has been mostly used by surgeons to train for certain procedures, such as laparoscopic surgery, prior to engaging in simulations (Aoun, et al., 2011; Eldred-Evans, et al., 2013), by nurse trainees to practice intramuscular injection (Doheny, 1993), and more recently, to assess and manage patient deterioration (Ignacio, et al., 2016). Using such a strategy, alone or as an integral component of a stress management programme, was effective in decreasing stress and improving performance in a group of inexperienced surgeons (Arora, Aggarwal, Moran, Sirimanna, Crochet, et al., 2011; Wetzel, George, Hanna, Athanasiou, Black, et al. 2011). This is believed to be due to the transformation of thoughts and emotions associated with stressful events after MR practice

(Jones & Stuth, 1997). Furthermore, MR has been shown as a form of stress inoculation that helps trainees manage their own stress as evidenced by lower objective and subjective stress measures (Arora, et al., 2011).

The potential benefits of the MR strategy in terms of enhancing performance and reducing stress in assessing and managing patient deterioration have been previously demonstrated using pre- and post-test combined with focus group interviews (Ignacio, et al., 2016). The evidence, however, may be limited as the MR strategy was not compared to another strategy that has already been shown to be effective. This other strategy, the conventional strategy, was used to teach nursing students how to assess and manage patient deterioration by means of the Airway, Breathing, Circulation, Disability, Exposure (ABCDE) mnemonic and simulations using high-fidelity mannequins. This technique has been shown to benefit performance (Liaw, Rethans, Scherpbier, Klainin-Yobas, 2011). Hence, to determine whether the MR strategy really enhances performance, the study aimed to compare the immediate effects of the MR strategy with the conventional strategy on performance and stress in simulated patient deterioration scenarios. The study also aimed to determine the usefulness of the MR strategy later on in actual clinical settings.

3. METHODS

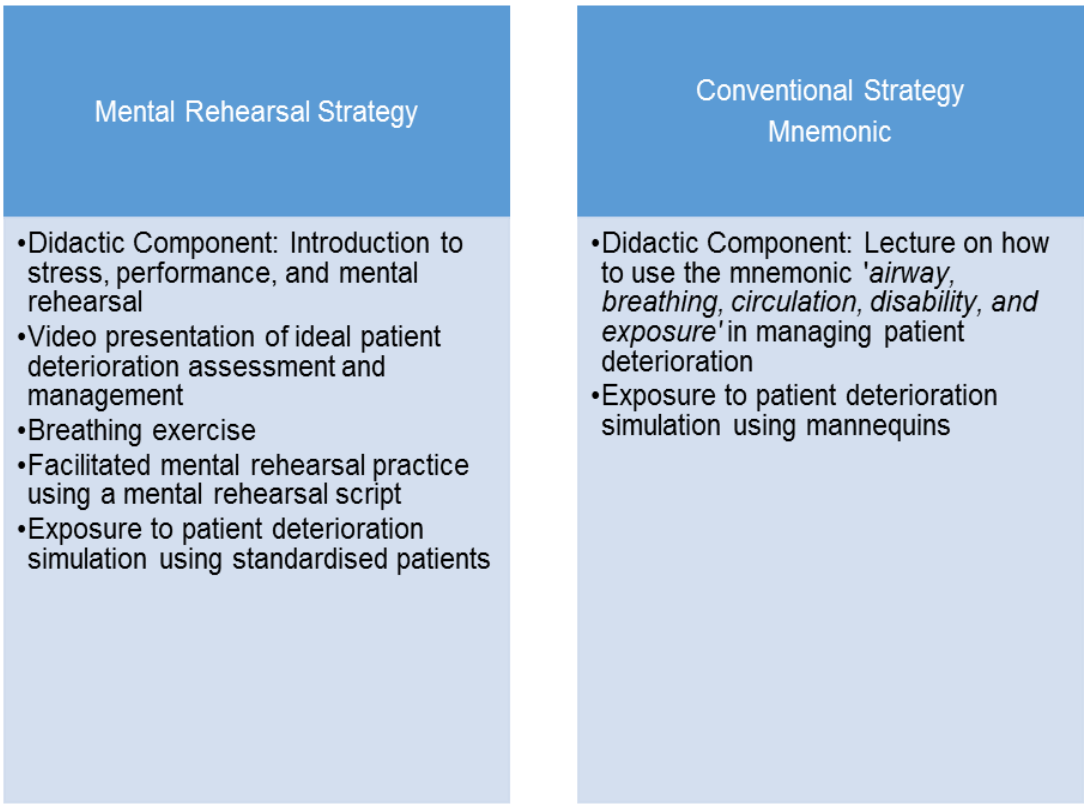
3.1. Study Design and Participants

A mixed methods study comprising of a randomised post-test design and a qualitative interview was conducted. The combination of quantitative and qualitative methods was used as this can moderate the limitations, and

leverage on the combined strengths of each individual approach (Johnson & Onwuegbuzie, 2004).

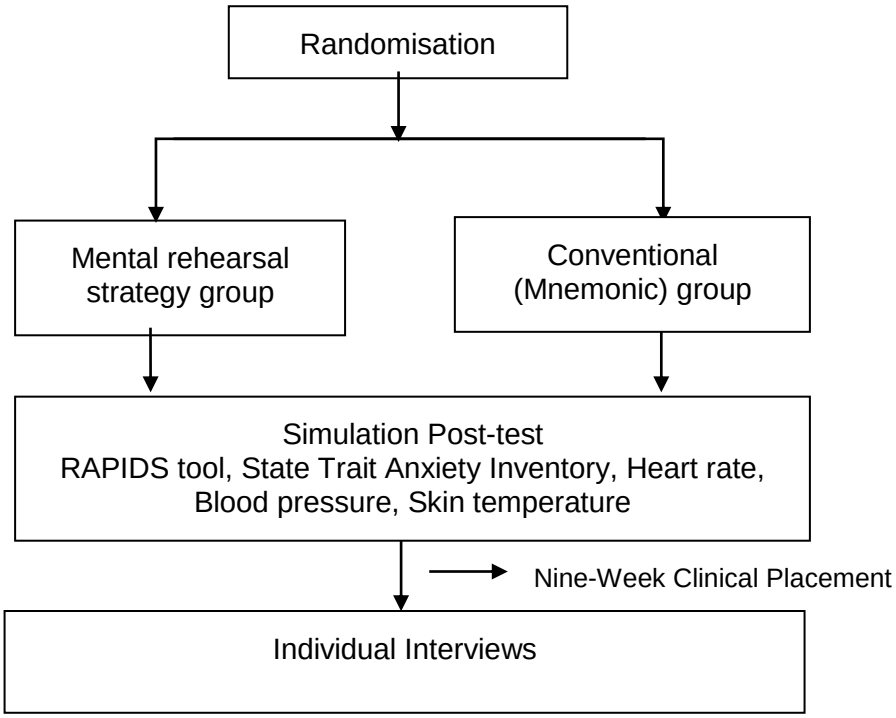
Upon ethics approval from the university's institutional review board, all third year nursing students (n = 93) enrolled in a Clinical Decision-Making module in a university in Singapore were invited to join the study. A total of 33 students consented to participate. Using a computer-generated randomiser, 17 students were randomised to the intervention group (MR-SP) and 16 students were placed in the control group (MM). The intervention consisted of a MR strategy that was developed and previously tested on a group of final year nursing students (Ignacio, et al., 2016). It consisted of a didactic component about stress and performance, a video of an ideal patient deterioration assessment and management, a breathing exercise, a mental rehearsal script, and a patient deterioration simulation using standardised patients (SPs). The complete MR strategy lasted for one hour and was conducted by the main researcher. In addition, those in the MR-SP group were given the MR script and were encouraged to practice MR as often as possible. The control, meanwhile, consisted of the conventional method in which students were taught to manage deteriorating patients by using the ABCDE mnemonic and exposure to patient deterioration simulation using mannequins. This also lasted for an hour. Figure 1 represents the details of the MR strategy and the conventional strategy.

Figure 1: The mental rehearsal strategy and the conventional strategy



All study participants were familiar with the ABCDE mnemonic as this was taught in the Clinical Decision-Making module. One participant who was assigned to the MM group withdrew due to schedule conflicts. The MR-SP and MM groups then underwent a post-test deteriorating patient simulation with SPs two weeks later as the SPs approximate the reality of a patient encounter. The 32 participants who completed this quantitative study component were invited to participate in individual interviews conducted after their nine-week clinical posting. Twenty-one students agreed to join. The study's flow diagram is presented in Figure 2.

Figure 2: Flowchart of the study



The qualitative component of the study consisted of 45 to 60 minute individual interviews. Twenty-one students (n = 21) from the original 32 participants were interviewed. The participants who were interviewed consisted of 11 participants from the MR-SP group and 10 participants from the MM group.

3.2. Data Collection and Outcome Measures

The demographic data, which included age, gender, and ethnicity, were collected from all participants. Performance and stress measures were done on both the MR-SP and MM groups during the post-test to determine the effectiveness of the MR strategy.

3.2.1. Performance

Performance was measured using the Rescuing A Deteriorating Patient In Deteriorating Situations (RAPIDS) tool. The RAPIDS tool is a valid and reliable instrument which consists of checklists and global rating scales that measure the simulation and clinical performance of nurses as they assess, manage, and report patient deterioration (Liaw, et al., 2011a).

3.2.1. Stress

Stress was measured using the Strait-Trait Anxiety Inventory (STAI) which has an acceptable reliability and validity in research settings (Vitasari, Wahab, Othman, Herawan, & Sinnadurai, 2011). This instrument consists of separate measures for state and trait anxiety. The 20-item state anxiety measures the anxiety felt by the respondent at that particular moment of time when he/she is answering the STAI whereas the trait anxiety measures how anxiety is generally perceived by the respondent (Spielberg, 1983). Physiologic determinants of stress such as heart rate, blood pressure, and skin temperature were also measured. An increase in heart rate and blood pressure due to catecholamine release is an expected result of the activation of the sympathetic-adrenal-medullary axis after stress exposure (Huang, Webb, Zourdos, & Acevedo, 2013). Skin surface temperature is decreased during sympathetic response as the blood supply is enhanced to vital organs (Hjemdahl, 2000).

The participants' performances were rated by the faculty staff who were familiar with deteriorating patient simulations and who had been trained with the use of the RAPIDS tool. The raters were blinded to the identities of the participants as each participant wore a cap, a gown, and a mask during the post-test simulation. After the quantitative component of

the study, the students who were randomised to the MM group were also given a copy of the MR strategy script and video.

The individual interviews were conducted after the participants' nine-week clinical placement, five months after they had the intervention. These interviews were facilitated by a member of the research team who was experienced with this task. The interviews were audio-recorded and the participants were queried regarding their experience with patient deterioration during their clinical placement and the practical application of the MR strategy in the clinical setting. The guide questions used are presented in Table 1.

Table 1
Guide questions for the individual interview

Interview guide questions
1. During your nine-week posting, did you experience attending to a deteriorating patient? (Can you tell me more about it?)
2. Were you able to recall the steps that you needed to carry out to adequately assess and manage the patient? (Were you alone?)
3. How did you feel during the experience and what were your thoughts then?
4. Do you think that the mental rehearsal strategy that we introduced to you was actually helpful? Why do you think so?
5. Any additional comments you want to give?

3.3. Data Analysis

The data gathered from the randomised post-test component was analysed using descriptive statistics. An independent t-test was used to compare the post-test outcome measures between the MR-SP group and the MM group. Audio-recorded individual interviews were transcribed verbatim and thematic analysis was used to make sense of and find the meanings in the

participants' experiences (Braun & Clarke, 2006). Credibility, conformability, dependability, and transferability were maintained to ensure the rigour of the qualitative data analysis (Polit & Beck, 2006). An audio-recording of each interview and member-checking for accuracy by a summary at the end of each interview ensured credibility and dependability. Confirmability was safeguarded after two researchers independently analysed the interview scripts before coming together to generate the final themes. The applicability of the findings to clinical settings from the generated data were assessed to demonstrate transferability.

4. RESULTS

4.1. Participant Demographics

A total of 32 final year nursing students completed the randomised post-test component of the study. Most of the participants were Chinese (75%), female (84.4%), have a mean age of 21.69 years, and who have completed junior college education (84.4%) prior to attending university (Table 2).

Table 2
Demographic characteristics of the participants (n = 32)

Demographic characteristics	Mean (SD)	
Age (years)	21.69 (1.230)	
	Total (%)	
Gender		
Male	5	(15.6%)
Female	27	(84.4%)
Ethnicity		
Chinese	24	(75.0%)
Malay	3	(9.4%)
Indian	5	(15.6%)
Others	0	(0%)
Education		
Polytechnic	5	(15.6%)
Junior College	27	(84.4%)

4.2. Performance

There was no difference between the performance of the MR-SP group and the MM group using the RAPIDS tool during the post-test (p=0.105). This suggests that participants from the MR-SP group had the same performance skills as those from the MM group after going through the MR strategy. The results for performance are presented in Table 3.

Table 3

Performance (n = 32)

	Mental Rehearsal (MR-SP) Group (n = 17)	Mnemonic (MM) Group (n = 15)	*t* values
	M (SD)	M (SD)	
RAPIDS Tool Scores	67.88 (11.42)	62.13 (7.27)	1.672

**Significant at <0.05*

4.3. Stress Levels

The post-test stress levels of the participants from the MR-SP group did not significantly differ from those in the MM group. This was evidenced by the physiologic measures of stress such as systolic blood pressure (p=0.890), heart rate (p=0.692), and skin temperature (p=0.521). The state (p=0.524) and trait (p=0.516) anxiety inventory results also did not differ between the two groups. Table 4 shows the stress level results for the different measures used.

Table 4

Stress

Outcome Measures	Mental Rehearsal (MR-SP) Group (n = 17)	Mnemonic (MM) Group (n = 15)	*t* values
	M (SD)	M (SD)	
Systolic Blood Pressure	118.06 (10.89)	117.47 (13.098)	0.140
Heart Rate	85.94 (19.57)	83.73 (19.572)	0.401
Skin Temperature	27.83 (3.02)	27.18 (2.57)	0.650
State Anxiety	36.82 (9.66)	39.07 (9.989)	-0.645
Trait Anxiety	39.06 (9.57)	41.20 (8.419)	-0.658

**Significant at <0.05*

4.4. Individual Interviews

Twenty-one students who participated in the randomised post-test component of the study were individually interviewed. Three themes emerged from the script analysis: (1) being mentally and emotionally prepared; (2) recalling and visualising the steps to be taken; and (3) enhancing actual clinical practice.

4.4.1. Being mentally and emotionally prepared

Good preparation has been mentioned by some of the participants as essential in managing acute clinical events such as patient deterioration. Mental preparation is one form of preparation that equips students to manage similar clinical incidents. In fact, one participant mentioned:

"I think having a good mental preparation is very good for us before we perform any procedure… We really need to prepare the patient and prepare ourselves, and mental rehearsal plays an important role in preparing ourselves." (P1)

By being mentally prepared, some felt that they became more aware of what to look out for and assess in the patient. For example, one participant mentioned:

"I was worried that the patient will deteriorate more so I also assessed the patient's general condition… I was more vigilant to his condition." (P17)

The mental preparedness also has been perceived by some of the participants to promote the mitigation of stress as after practicing it, they know better what to do and thus become less stressed. Examples of what some of the participants mentioned are as follows:

"I think most of the time stress comes from not knowing what to do in a stressful situation. Yeah, so when you know you have something to do then it eliminates that part of the stress where you feel "Oh no what am I supposed to do now?" (P5)

"I think it definitely helps to decrease stress to a considerable level… Once you are calmer because you have already mentally prepared yourself, then you…

of course, what follows then you know what to do, better than your stress level off, then you also will follow to be decrease." (P12)

4.1.2. Recalling and visualising the steps to be taken

Most of the participants commented that mental rehearsal made it easier for them to recall certain information that they needed in order to perform well. This was summed up by one participant who commented:

"Actually it helps in remembering and then prepare you in what to anticipate." (P11)

Some felt that the integration of a storyline founded on the ABCDE mnemonic in the MR script helped visualise and recall the steps better. In fact, one participant noted:

"It puts the scenario in a storyline rather than just using the ABCDE, (it's) easier to visualise… With more practice using it, I got more familiar with the ABCDE and clinically, it is important." (P3)

Mental rehearsal has also been seen as a retrieval tool that helps in terms of remembering stored information or previous knowledge. For instance, one participant mentioned:

"…it's like a retrieval tool… You must have knowledge before, then with the mental rehearsal, you can use it to draw out the information that you have or you know." (P17).

4.1.3. Enhancing actual clinical practice

The use of the MR strategy has been perceived by the majority of the participants to facilitate in learning by bridging the gaps that exist between

what they learn in school and what they are expected to do in an actual clinical setting. One participant said:

"Because in the ward, I think the source of our nervousness is our lack of knowledge and also lack of practice and everything. So with the mental rehearsal, I think you can bridge a bit of the gap." (P18)

As MR facilitates learning by integrating various information or knowledge acquired during training, it has to be practiced often. In fact, one participant suggested:

"…implement it more frequently… because I really think it's something we should practice, practice more so we can use it like it's at the tip of our fingers…" (P12)

One participant summarised it well when she mentioned:

"If mental rehearsal becomes part of how we think, then it will help." (P14)

Interestingly, the use of the MR strategy has been perceived by some as a means to reflect on their learning such that they first practice MR, apply it to an actual event, and then modify their own MR to improve subsequent performances. For example, one participant noted:

"You get to think about what you could have done, what you should have done better, and then rehearse all the different steps so that you can be prepared for another similar case." (P6)

5. DISCUSSION

From the findings of the study, it appears that the MR strategy with SP simulations has no advantage over the use of the ABCDE mnemonic with mannequin simulations. There was no significant difference in the performance scores between the MR-SP group and the MM group in terms of assessing and managing patient deterioration. The use of MR-based interventions in training has been shown to improve the performance of highly technical skills such as laparoscopic cholecystectomy and intramuscular injections, and more complex skills such as patient deterioration management (Arora, et al., 2011; Doheny, 1993; Eldred-Evan, et al., 2013; Ignacio, et al., 2016). However, unlike previous studies, this study tried to compare the effects of the MR strategy and a conventional strategy in training to assess and manage patient deterioration using a randomised post-test. Despite that, the results did not corroborate the findings of enhanced performance that was evident in the studies mentioned.

The use of the ABCDE mnemonic combined with simulation using mannequin has been utilised to teach students on the management of deteriorating patients. Such a method has been demonstrated as effective in enhancing nursing students' performance when they are presented with a deteriorating simulated patient (Liaw, et al., 2011b). The results of this current study suggest that there is no difference between the use of the ABCDE mnemonic and mannequin simulation and the use of the MR strategy with SP simulation in terms of enhancing performance. The cohesiveness of the MR script included in the strategy results in an imagination effect. This imagination effect facilitates a better absorption of the learning material; in this instance, the assessment and management of

patient deterioration (Ignacio et al. 2016; Leahy & Sweller 2008). Hence, it appears that MR has more benefits for long-term memory storage (Ignacio et al 2016; Leahy & Sweller 2004, 2008). This reasoning is in line with the qualitative findings of this study which showed that the students found the use of MR useful as they are able to recall what they needed to do, especially because the script was presented in a story format which they were able to easily visualise. Furthermore, the MR script can be used independently without the other components of the strategy. The script can be used by the learners at their own convenience. Hence, there is no limit to the number of times one can practice. Interestingly, the matter regarding practice also came out during the interviews under the theme 'enhancing actual clinical practice'. The participants generally felt that the more MR is used, the more likely it can improve performance.

One probable explanation for why there was no significant difference between the performance mean score of the participants in the MP-SP compared to the MM group was that the MR strategy was only given once. After the facilitated MR practice, the participants in the MR-SP group were encouraged to do use MR strategy (minus the SP simulation) on their own at their own convenience. Hence, during this time of independent practice, no feedback was given. MR solely relies on the recreation of the task from memory, resulting in a more developed mental representation of the task (Frank, Land, Popp, & Schack, 2014), however, this may not translate to improved performance unless there is available feedback, which may not be present when one independently practices MR. Although MR can be practiced individually anytime and anywhere, it may be necessary to have any form of feedback after individual MR practice sessions. Feedback, when a post-MR simulation is not possible, can come from the video of the skill or from the presence of someone who could go through the steps with the

trainee after his/her individual MR practice. It has been reported that the benefits of the MR strategy may prove to be self-limiting when performance feedback is unavailable (Driskell, 1994). Hence, as it was mentioned by some students during the interviews, MR is one strategy that can bridge the gaps in learning. Some of the participants who were interviewed saw the MR strategy as a means to reflect on what went wrong during their actual clinical experience. After experiencing an actual clinical event, the students reflect and integrate new information into their MR practice so that they can improve for future experiences. As such, the strategy can also be linked with the principle of experiential learning, which is important in acquiring knowledge (Kolb, 1984). This learning principle can be valuable to both technical and non-technical knowledge acquisition.

Both physiological and self-report stress measures did not show any difference between the MR-SP group and the MM group. MR has been noted to reduce stress and relieve anxiety (Arora, et al., 2011; Cocks, et al., 2014). This premise, on the other hand, was not supported by the results of this study. Both groups were assessed on performance for the post-test and this could have mitigated the effects of the intervention on the MR-SP group's stress levels as any form of assessment is considered stressful and could potentially induce anxiousness (Marshall & Jones, 2003). However, the findings from the individual interviews suggest that the MR strategy facilitated stress reduction. The participants from both the MR-SP and the MM groups concurred that preparation is needed prior to exposure to critical clinical events. Technical competence, such as the ability to properly assess patients, and emotional competence, such as their ability to cope with stress, were seen as vital in managing deteriorating patients, in concordance with what has been mentioned in literature (Ignacio, et al.,

2016; LeBlanc, 2009; Liaw, et al., 2012). Mental preparation was generally perceived as a means to be ready in anticipating patient deterioration, and a component of being mentally prepared is having done a mental rehearsal of the critical event. Thus, MR not only prepares the students for the task at hand, but also to be less stressed when managing an acute critical event (Ignacio, et al., 2016).

5.1. Limitations

The mixed methods design provided the needed strength for the study. The randomised post-test component provided the quantitative data needed to compare the effectiveness of two interventions that have been shown to improve performance and reduce trainee stress. The individual interviews of some of the participants, which have not been done on previous similar studies, provided rich qualitative data regarding the practical use of the MR strategy in a clinical setting. The findings from the qualitative component of the study added to the holistic evaluation of performance and stress levels. However, the study has some limitations that warrant attention. A pre-test would be a useful component for the randomised design as it could determine which group had a significant improvement from the baseline to its post-test. This was not done to avoid the practice effect which would inevitably improve performance for both groups (Heiman, 2002). Also, as all the participants were familiar with the ABCDE mnemonic, the results of the participants in the MR-SP group may not have just resulted from the MR strategy but rather from this knowledge and various other elements contained in both the intervention and conventional conditions of the study. Thus, adding a third distinct intervention arm to the study may be of value. The SPs in deteriorating patient simulations were only used in training the MR-SP group but not the MM group. As the previous studies of

this research team showed that SPs have benefits in deteriorating patient simulation training, (Ignacio, et al., 2016; Ignacio, et al., 2015) both MR-SP and MM groups should have the SPs in training. Such a design will attribute the results of the study solely to the MR strategy or to the ABCDE mnemonic without being confounded by the SP methodology. However, using mannequins in a simulation has always been a component of the conventional strategy used in teaching students about patient deterioration management. A change in SPs will make the strategy unconventional. Finally, the individual MR strategy practice sessions and actual physical practice sessions of the participants should have been closely monitored and correlated with the results. These should be addressed in future studies and it would be valuable to measure the long-term effects of the MR strategy on clinical practice.

6. CONCLUSION

The use of a MR strategy with a SP simulation was compared to the use of the ABCDE mnemonic with a mannequin simulation to teach final year nursing students about patient deterioration management. Performance and stress levels were evaluated. Performance scores between the two groups did not differ. The quantitative measures of stress were also not significant. On the other hand, the qualitative data from the individual interviews showed that the MR strategy prepared students mentally and emotionally for patient deterioration encounters in actual clinical practice. The use of MR also enables its learners to recall information and visualise the steps regarding the assessment and management of patient deterioration. Finally, practicing MR can be used to enhance actual clinical practice. These overall findings suggest that the MR strategy cannot be

easily dismissed as an intervention to train healthcare professionals. It can still be a viable intervention or strategy to improve performance and to decrease stress in health professions training.

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CHAPTER 7

General Discussion

SUMMARY

Chapter 1 contains the general introduction of the thesis. It describes the background, the rationale for undertaking the project, the aims and the research questions that this thesis addresses.

The clinical setting is replete with challenging clinical events that result in health professionals' experiencing stress. This is particularly true in clinical crisis events that happen acutely. As an emotional response, stress can affect the performance of clinical tasks and as a result, patient management. At right amounts, stress can result in competent performance of a clinical skill. At excessive amounts, however, it can impair performance such that patient management may be compromised. It was thus suggested that an emotional training strategy that addresses non-technical skills, such as stress management, is vital to health professions education. Simulation is increasingly being used as a platform to train health professionals in technical skills needed for future practice hence, the stress management strategy should be able to be seamlessly integrated into simulation training to meet its goals. By including such a strategy in training, it was expected that clinical performance will also be improved. There was a limited amount of literature in health professions education on how emotional training strategies, specifically stress management strategies, were used in healthcare simulation to train health professionals to reduce stress and improve performance during clinical crisis events. With this in view, we set out to determine the place of emotional training strategy in simulation-based learning of acute situations. To answer this, four main research questions were formulated:

1. *What strategies are used to reduce trainees' stress during crisis event simulations and what is known about their effectiveness?*

2. What are the effects of using standardised patients versus high-fidelity simulators on student performance and stress reduction?

3. What are the effects of a developed mental rehearsal strategy on student performance and stress reduction?

4. What are the effects of an improved mental rehearsal strategy integrated into simulations on student performance and stress reduction?

Chapter 2 partly answers the research question, "*What strategies are used to reduce trainees' stress during crisis event simulations and what is known about their effectiveness?*" It does so by firstly giving an overview of how health professionals are constantly exposed to stressors in the clinical environment, and how these stresses could affect patient safety and patient management. Secondly, this chapter demonstrates, the relationship between emotional responses, particularly stress and anxiety, and performance. Thirdly, it explains how the use of simulations could facilitate emotional training in nursing training guided by experiential learning. As experience is needed to learn and be proficient at any skill, it was also assumed that management of excessive stress could be developed through experience, particularly in highly realistic settings, such as in simulations. Finally, some of the strategies, such as mindfulness training, muscle relaxation and mental rehearsal that could be integrated into the nursing simulation training and curriculum to facilitate both skills and emotional training are expounded on.

The chapter closes by concluding that stress or anxiety are usually manifested by the nurses when they deal with high-acuity clinical events. Excessive stress and/or anxiety elicited during these critical hospital moments could impair performance and could result in detrimental effects

on patient management and care. As there are already some strategies that have been used to reduce stress/anxiety in general settings, such as the ones mentioned in the preceding paragraph, the utilisation of any one or a combination of these could be integrated into the nursing curriculum, particularly in simulation training to reduce excessive stress/anxiety.

The research question, "*What strategies are used to reduce trainees' stress during crisis event simulations and what is known about their effectiveness?*" is further answered in **Chapter 3**. This chapter reports a literature review which was conducted to explore existing strategies used with simulations to enhance the ability of health professions trainees to reduce acute stress during high-acuity clinical events. This chapter explores the relative effectiveness of these strategies on stress management as these emotional responses can adversely affect performance during clinical crisis events. To address these aims, Scopus, PubMed, CINAHL, Web of Knowledge and Science Direct databases were searched. Peer-reviewed empirical papers that focused on the strategies addressing stress and/or anxiety during simulation training for healthcare professions' trainees were appraised. Only those papers written in the English language and published from January 2005 to March 2015 were included. The literature review findings highlighted in this chapter, shows eight studies using various forms of stress/anxiety management strategies with simulations. These studies demonstrated varying degrees of effectiveness in terms of stress and/or anxiety reduction. The themes that emerged from these eight studies, such as excessive stress and clinical performance in simulation, emotional training strategies in simulation, and factors contributing to stress and anxiety reduction during simulation, are further discussed in this chapter. Finally, from the discussions in this chapter, it was concluded that excessive stress and/or anxiety in the clinical setting truly affect

performance and could compromise patient outcomes. Health professions training curricula, thus, might benefit from a stress/anxiety reduction strategy that could be integrated into their simulation programmes. We have also recommended that further studies need to be done to test the effectiveness of existing strategies in reducing stress and/or anxiety as the results pertaining to their effectiveness were equivocal. Furthermore, as most of them were conducted in surgical training, it would be valuable to see their usefulness in the training of other healthcare disciplines.

Chapter 4 answers the research question, "*What are the effects of using standardised patients versus high-fidelity simulators on student performance and stress reduction?*" It highlights a mixed methods study that compares the use of standardised patients (SPs) with high-fidelity simulators (HFS) in deteriorating patient simulations in terms of stress and performance. The use of SPs adds realism to a simulation scenario and this realism is thought to be valuable in preparing nurse trainees for stress and enhancing their performance during actual patient deterioration. In the control group design component of the study, where participants were randomised to either the SP group or the HFS group, pre- and post-tests were conducted to evaluate stress and performance in deteriorating patient simulations. Fifty-seven nursing students participated. Performance was assessed using the Rescuing A Patient in Deteriorating Situations (RAPIDS) rating tool. Stress was measured using salivary alpha-amylase levels. Fourteen participants from the randomised controlled component then participated in focus group discussions that elicited their insights on SP use in patient deterioration simulations. Using analysis of covariance (ANCOVA) results showed no significant difference, between the performance scores of the SP and HFS groups in managing deteriorating patients. Amylase levels were also not significantly different between the two groups. Three themes were

generated from thematic analysis of the focus group discussions. The three themes are: *stress in simulation*, *awareness of patient interactions*, and *realism*. These themes suggest that the participants recognised the presence of stress in simulations, and that using SPs made them cognizant of the need to be aware of how they interact with patients. In addition, they found that the SPs added to authenticity to the clinical scenario.

The chapter further expounds on the possible reasons that led to the quantitative results, and gives a detailed explanation of the themes that emerged. It also proposes how the limitations of this study could be addressed in future research.

Chapter 4 concludes by acknowledging the contradicting results of the quantitative component and the focus groups component of the study. Although the control group design study showed no differences in stress and performance between the SP group and the HFS group, the focus group interviews for both groups suggested that the use of SPs had advantages over the use of mannequins in patient deterioration simulations as the former more closely mimicked real patient encounters. Potential advantages, however, need to be further explored, and its impact on actual clinical practice needs to be further investigated.

Chapter 5 underscores mental rehearsal (MR) as a form of mental training that has been successfully used by physicians and nurses to improve performance of clinical skills, and as a vital component of stress management training. This chapter describes the development, implementation and evaluation of an MR strategy that could be integrated into simulation to improve nursing students' clinical performance and stress management during critical clinical events, such as patient deterioration. To help novice nurses deal with often stressful clinical events

that require the processing of information essential to patient management, this MR strategy was developed and implemented in a final year nursing simulation programme. Furthermore, a pre- and post-test design study participated in by 18 final year nursing students is described in this chapter.

The research question that this chapter addresses is, "*What are the effects of a developed mental rehearsal strategy on student performance and stress reduction?*" To answer this question, the quantitative study component used the RAPIDS rating tool to assess performance, and heart rates and systolic blood pressures, meanwhile, to measure stress. The State-Trait Anxiety Inventory (STAI), a psychological measure of stress/anxiety, was also used. The usefulness of the MR strategy was also qualitatively evaluated in this chapter using a focus group interview participated in by five nursing students who initially participated in the pre- and post-tests. The results reveal a significant improvement in performance between the pre and post-test scores. However, post-test heart rate and systolic blood pressure are not significantly different from pre-test measures. A comparison of STAI results did not show significant differences between pre- and post-test state anxiety and pre- and post-test trait anxiety. *Managing stress*, *using a mental framework* and *integrating realistic simulations with the MR strategy* are the themes that emerged from the qualitative analysis.

From the qualitative analysis, it was concluded that the participants perceived that the MR strategy has benefits in improving performance, thus supporting the findings of the pre- and post-tests. The MR strategy resulted in a significant improvement in performance scores during the post-test compared to the pre-test. Stress, nonetheless, remained unchanged. The

strategy, therefore, has the potential to enhance student learning in simulation training, particularly in patient deterioration simulations. Future studies should look into developing it into a more robust strategy incorporated in realistic simulations to help enhance students' ability to translate theory to practice and promote patient safety.

In **Chapter 6**, a mixed methods study on an improved MR strategy which was developed, implemented and evaluated for final year nursing students in Chapter 5 is discussed. The central research question that this chapter tries to answer is, "*What are the effects of an improved mental rehearsal strategy integrated into simulations on student performance and stress reduction?*"

In this chapter, the MR strategy is implemented integrated *into* with simulations that utilise SPs. This chapter compares the effects of the MR in simulation strategy with the use of the airway, breathing, circulation, disability (ABCDE) mnemonic on the performance and stress levels of final year nursing students in assessing and managing patients in deterioration. The study featured in this chapter is a mixed methods design which consists of a randomised control group post-test followed-up by individual interviews. There were 32 final year nursing students who participated in the post-test. They were randomised to either the MR strategy in simulation (MR-SP) group or mnemonic (MM) group. Measures of performance used was the RAPIDS tool; stress measures were: the Strait-Trait Anxiety Inventory (STAI), heart rate, systolic blood pressure, and skin temperature. There were 21 students who were interviewed individually as part of the qualitative component of the study after their nine-week clinical placement. This was to explore the students' views on the effects of the strategy on stress and performance in actual settings. There were no

significant differences in performance scores between the MR in simulation group and the mnemonic group. The STAI, systolic blood pressure, heart rate, and skin temperature also were not significantly different. Three themes that emerged from the interviews indicated that the participants viewed the value of the MR strategy in simulation in the area of *being mentally and emotionally prepared*, *recalling and visualising the steps to be taken*, and *enhancing actual clinical practice*.

In conclusion, it was found that the MR in simulation and the mnemonic strategies had similar effects on performance and stress during patient deterioration management. The interviews, nonetheless, suggest that the MR strategy still benefits learning and could be used as an added strategy in other health professions' training. This chapter explores the possible reasons for study components' divergent findings, such as number of facilitated sessions, assessment-like nature of the post test, and lack of feedback when the MR strategy is done individually by students. Limitations of the featured study in this chapter are also discussed such that these could be addressed by future research.

In the final chapter, **Chapter 7**, the research questions posed in the beginning of this thesis are answered and elucidated. Furthermore, this chapter discusses how each of the scholarly work described from Chapters 2 to 6 are interconnected.

Based on the studies performed we conclude the following: (1) strategies used to reduce stress in simulations differ in terms of their effectiveness; (2) addition of SPs did not affect stress and performance measures but SPs have been perceived to add realism and prepare students for the actual clinical setting, showing its potential advantage in training for actual clinical practice; (3) the MR strategy showed promise only in

improving performance despite its perceived positive effects on stress and performance, which suggest that a more robust MR strategy may in fact benefit learning, particularly of managing deteriorating patients; and (4) MR strategy integrated *into* simulations with SPs did not prove superior to the mnemonic strategy using mannequins, again despite positive student perceptions on the strategy, suggesting the need to further investigate the effects of the strategy on stress and performance in patient deterioration simulations.

The main implications of these studies to health professions education is the potential value of developing and constantly improving an emotional training strategy that could reduce stress and that could be integrated in simulations to train nurses, and eventually other healthcare professionals. Such a strategy could have vital effects on patient management and patient safety as stress could impair performance at excessive amounts. Suggestions on relevant future studies and how these studies could leverage on the findings extrapolated in this thesis are also described in Chapter 7.

SAMENVATTING

Summary in Dutch

Hoofdstuk 1 geeft een algemene inleiding tot het proefschrift. Het beschrijft de achtergrond, de reden waarom we dit project ondernamen, de doelen en de onderzoeksvragen die in dit proefschrift worden beantwoord. In de klinische setting komen zorgprofessionals voor veel klinische uitdagingen te staan die hun stress bezorgen. Dit geldt vooral bij acute medische spoedgevallen. Stress, als emotionele reactie, kan de uitvoer van klinische taken en daarmee de behandeling van patiënten beïnvloeden. Gedoseerd kan stress leiden tot een adequate uitvoering van een klinische vaardigheid. Te veel stress kan de prestaties echter dusdanig verminderen dat de behandeling van patiënten in gevaar wordt gebracht. Daarom werd geopperd dat een emotionele trainingsstrategie gericht op het aanleren van niet-technische vaardigheden, zoals omgaan met stress, van essentieel belang is voor het gezondheidszorgonderwijs. Simulatie wordt steeds vaker aangewend als medium om zorgprofessionals de technische vaardigheden aan te leren die voor de toekomstige praktijk vereist zijn. De omgaan-met-stressstrategie zou daarom eenvoudig voor zijn doeleinden in simulatietrainingen moeten kunnen worden ingebouwd. Door een dergelijke methode in de trainingen op te nemen verwachtten wij dat de klinische prestaties ook zouden verbeteren. Op het gebied van het gezondheidszorgonderwijs was er weinig literatuur beschikbaar over hoe emotionele trainingsstrategieën, in het bijzonder omgaan-met-stressstrategieën, in zorgsimulaties werden gebruikt om zorgprofessionals te leren stress tijdens medische spoedgevallen te verminderen en prestaties te verbeteren. Met dit voor ogen, stelden we ons ten doel om de plaats van emotionele trainingsstrategieën in het leren van acute situaties door middel van simulatie te bepalen. Om dit te beantwoorden stelden we vier onderzoeksvragen op:

1. *Welke strategieën worden er gebruikt om stagiairs' stress te verminderen tijdens simulaties van spoedgevallen en wat is er bekend over hun effectiviteit?*

2. *Wat zijn de effecten van het gebruik van gestandaardiseerde patiënten ten opzichte van hoog-realistische simulatoren op de studentprestaties en stressvermindering?*

3. *Wat zijn de effecten van een ontwikkelde mentale oefeningsstrategie op de studentprestaties en stressvermindering?*

4. *Wat zijn de effecten van een in simulaties geïntegreerde, verbeterde mentale oefeningsstrategie op de studentprestaties en stressvermindering?*

Hoofdstuk 2 geeft deels antwoord op de onderzoeksvraag "Welke strategieën worden er gebruikt om stagiairs' stress te verminderen tijdens simulaties van spoedgevallen en wat is er bekend over hun effectiviteit?". In de eerste plaats doet het dat door een overzicht te geven van hoe zorgprofessionals in de klinische omgeving continu aan stressveroorzakende factoren worden blootgesteld, en hoe deze spanningen de veiligheid en behandeling van patiënten kunnen beïnvloeden. Ten tweede toont dit hoofdstuk het verband tussen emotionele reacties, in het bijzonder stress en angst, en prestaties. Ten derde wordt uitgelegd hoe het gebruik van simulaties emotionele training in het verpleegkundeonderwijs aan de hand van ervaringsleren kan faciliteren. Aangezien ervaring nodig is om te leren en om welke vaardigheid dan ook te beheersen, gingen we ervan uit dat omgaan met te veel stress door ervaring kon worden ontwikkeld, vooral in hoog-realistische settingen, zoals bij simulaties. Ten slotte wordt een

uiteenzetting gegeven van enkele strategieën, zoals mindfulnesstraining, spierontspanning en mentale oefening, die in simulatietrainingen en het curriculum van de verpleegkundeopleiding zouden kunnen worden opgenomen ter bevordering van zowel vaardigheden als emotionele training.

Het hoofdstuk sluit af met de conclusie dat stress of angst meestal bij verplegers de kop opsteekt wanneer zij met acute medische spoedgevallen te maken hebben. Als er tijdens deze kritieke ziekenhuismomenten te veel stress en/of angst wordt ervaren, zou dit de prestaties kunnen verminderen en nadelige gevolgen kunnen hebben voor de behandeling en zorg van patiënten. Aangezien er in algemene settingen al enkele strategieën worden toegepast om stress/angst te verminderen, zoals die in de vorige alinea werden genoemd, zou een willekeurige strategie of combinatie van deze strategieën ingebouwd kunnen worden in het verpleegkundecurriculum, in het bijzonder in simulatietraining, ter vermindering van te veel stress/angst.

De onderzoeksvraag “Welke strategieën worden er gebruikt om stagiairs’ stress te verminderen tijdens simulaties van spoedgevallen en wat is er bekend over hun effectiviteit?” wordt verder beantwoord in **Hoofdstuk 3**. Dit hoofdstuk beschrijft een literatuuronderzoek dat we ondernamen om bestaande strategieën in kaart te brengen die bij simulaties worden toegepast om ervoor te zorgen dat stagiairs in de zorg beter in staat zijn om acute stress tijdens medische spoedgevallen te verminderen. Dit hoofdstuk onderzoekt de respectieve effectiviteit van deze strategieën wat betreft

het omgaan met stress, omdat deze emotionele reacties de prestaties tijdens medische spoedgevallen nadelig kunnen beïnvloeden. Om dit doel te bereiken doorzochten wij de databases Scopus, CINAHL, Web of Knowledge en Sience Direct. Aan peer review onderworpen empirische artikelen die gefocust waren op strategieën voor de aanpak van stress en/of angst tijdens simulatietraining van stagiairs in de zorg werden beoordeeld. Alleen in het Engels geschreven en tussen januari 2005 en maart 2015 gepubliceerde artikelen werden geïncludeerd. De bevindingen van het literatuuronderzoek die in dit hoofdstuk worden belicht laten acht studies zien waarbij diverse vormen van omgaan-met-stress/angststrategieën werden toegepast bij simulaties. Deze studies toonden diverse maten van effectiviteit wat betreft de vermindering van stress en/of angst. De thema's die uit deze acht studies naar voren kwamen, zoals te veel stress en klinische prestaties bij simulatie, emotionele trainingsstrategieën bij simulatie, en factoren die stress en angst helpen te verminderen tijdens simulatie, worden in dit hoofdstuk verder besproken. Uit de discussie in dit hoofdstuk werd uiteindelijk geconcludeerd dat een overmaat aan stress en/of angst in de klinische setting de prestaties inderdaad beïnvloedt en de patiëntenzorg in gevaar zou kunnen brengen. Curricula van opleidingen in de zorg zouden dus voordeel kunnen behalen als zij een stress/angstverminderingsstrategie in hun simulatieprogramma's opnamen. Gezien de tegenstrijdige resultaten met betrekking tot effectiviteit, was ons advies tevens om nader onderzoek te verrichten naar de effectiviteit van bestaande strategieën wat betreft stress- en/of angstvermindering. En ten slotte, aangezien de meeste strategieën werden toegepast in het chirurgisch onderwijs, zou het zinvol zijn om hun nut ook in het onderwijs van andere zorgdisciplines te onderzoeken.

Hoofdstuk 4 geeft antwoord op de onderzoeksvraag "Wat zijn de effecten van het gebruik van gestandaardiseerde patiënten ten opzichte van hoog-realistische simulatoren op de studentprestaties en stressvermindering?". Het bespreekt een mixed-methodsstudie waarbij het gebruik van gestandaardiseerde patiënten (SP's) vergeleken wordt, qua stress en prestaties, met dat van hoog-realistische simulatoren (HFS*) bij simulaties van achteruitgaande patiënten. Het gebruik van SP's

maakt een nagebootste situatie nóg echter, iets dat gezien wordt als waardevol voor de voorbereiding van verpleegkundestagiairs op stress en de verbetering van hun prestaties wanneer ze echt met een achteruitgaande patiënt te maken krijgen. In de controlegroep-designcomponent van de studie, waar deelnemers willekeurig werden ingedeeld in ofwel de SP-groep dan wel de HFS-groep, verrichtten we

voor- en nametingen van stress en prestaties tijdens simulaties van achteruitgaande patiënten. Zevenenvijftig verpleegkundestudenten namen deel. Prestaties werden gemeten aan de hand van het *Rescuing A Patient in Deteriorating Situations (RAPIDS)***-meetinstrument. Stress werd gemeten aan de hand van het alfa-amylasegehalte in speeksel. Veertien deelnemers uit het gerandomiseerde deel van het onderzoek met controlegroep namen vervolgens deel aan focusgroepgesprekken waarin er naar hun mening over het gebruik van SP's bij simulaties van achteruitgaande patiënten werd gevraagd. Uit de covariantieanalyse (ANCOVA) kwamen geen significante verschillen naar voren tussen de scores van de SP-groep en die van de HFS-groep op de manier waarop ze met achteruitgaande patiënten omgingen. De amylasegehalten van de twee groepen vertoonden ook geen significante verschillen. De thematische analyse van de focusgroepgesprekken leverde drie thema's op. De drie thema's zijn: "stress

tijdens simulatie", "bewustwording van patiëntinteracties" en "realisme". Deze thema's geven aan dat de deelnemers de aanwezigheid van stress tijdens simulaties erkenden, en dat zij dankzij het gebruik van SP's inzagen hoe belangrijk het is dat zij zich bewust waren van de manier waarop zij met hun patiënten omgingen. Daarnaast vonden zij dat de SP's de echtheid van de nagebootste klinische situatie vergrootten.

Verder worden in het hoofdstuk de mogelijke redenen voor de kwantitatieve resultaten op een rijtje gezet en worden de gedistilleerde thema's uitgebreid toegelicht. Ook wordt voorgesteld hoe de beperkingen van deze studie door toekomstig onderzoek kunnen worden ondervangen. Hoofdstuk 4 wordt afgesloten met een erkenning van de tegenstrijdige resultaten van het kwantitatieve deel en het focusgroepdeel van de studie. Hoewel de studie met controlegroep geen verschillen liet zien in stress en prestaties tussen de SP-groep en de HFS-groep, gaven de focusgroepgesprekken met beide groepen aan dat het gebruik van SP's voordelen had ten opzichte van het gebruik van fantomen bij simulaties van achteruitgaande patiënten, omdat SP-gesprekken meer op échte patiëntgesprekken leken. Mogelijke voordelen, alsook de invloed daarvan op de werkelijke praktijk, moeten echter nog nader worden onderzocht.

In **Hoofdstuk 5** ligt de nadruk op mentale oefening (MR***), d.w.z. een vorm van mentale training die succesvol door artsen en verpleegkundigen wordt gebruikt om de verrichting van klinische vaardigheden te verbeteren en die een onmisbaar onderdeel vormt van de training "omgaan met stress". Dit hoofdstuk beschrijft de ontwikkeling, invoering en evaluatie van een MR-strategie die in

simulaties kan worden opgenomen om de klinische prestaties van verpleegkundestudenten en de manier waarop zij met stress omgaan tijdens kritieke klinische situaties, zoals een patiënt die in achteruitgaande toestand verkeert, te verbeteren. Om junior verpleegkundigen te helpen omgaan met klinische situaties die vaak stressvol zijn en waarbij zij informatie moeten verwerken die essentieel is voor de behandeling van de patiënt, werd deze MR-strategie ontwikkeld en in het laatste jaar van een simulatieprogramma binnen de verpleegkundeopleiding ingevoerd. Verder wordt in dit hoofdstuk een studie met voor- en nameting beschreven waaraan 18 laatstejaarsverpleegkundestudenten hebben deelgenomen.

De onderzoeksvraag die in dit hoofdstuk aan de orde komt is “Wat zijn de effecten van een ontwikkelde mentale oefeningsstrategie op de studentprestaties en stressvermindering?”. Om deze vraag te beantwoorden werd in het kwantitatieve deel van het onderzoek gebruik gemaakt van het RAPIDS-meetinstrument om prestaties te beoordelen, terwijl stress bepaald werd aan de hand van hartslag- en systolische bloeddrukmetingen. Ook werd er gebruik gemaakt van de *State-Trait Anxiety Inventory (STAI)*-vragenlijst, een psychologisch instrument voor het meten van stress/angst op het niveau van de persoonlijke geneigdheid tot het ervaren van stress/angst en op het situatie-specifieke niveau. Het nut van de MR-strategie werd in dit hoofdstuk ook kwalitatief geëvalueerd door middel van een focusgroepgesprek met vijf verpleegkundestudenten die tevens aan de voor- en nametingen hadden deelgenomen. De resultaten laten een significante verbetering zien van de prestatiescores van de nameting ten opzichte van die van de voormeting. De hartslag- en systolische bloeddrukmetingen lieten echter geen significante verschillen zien tussen voor- en nameting. Een vergelijking van de STAI-resultaten liet

geen significante verschillen zien tussen de voor- en nameting van situatie-specifieke stress/angst (*state anxiety*), noch van de geneigdheid tot het ervaren van stress/angst (*trait anxiety*). “Het omgaan met stress”, “gebruik van een mentaal kader” en “integratie van realistische simulaties met de MR-strategie” waren de thema’s die uit de kwantitatieve analyse naar voren kwamen.

Uit de kwalitatieve analyse werd geconcludeerd dat de deelnemers vonden dat de MR-strategie de prestaties kan verbeteren, waarmee zij de bevindingen van de voor- en nametingen staafden. De MR-strategie zorgde voor een significante verbetering van de prestatiescores op de nameting ten opzichte van de voormeting. Desondanks bleef het stressniveau onveranderd. De strategie is dus in staat het leren van studenten tijdens simulatietrainingen, en dan met name tijdens simulaties van achteruitgaande patiënten, te bevorderen. Toekomstige studies zouden moeten onderzoeken hoe zij verder ontwikkeld kan worden tot een meer gedegen strategie die onderdeel vormt van realistische simulaties, teneinde ervoor te zorgen dat studenten beter in staat zijn theorie naar de praktijk te vertalen en de patiëntveiligheid te bevorderen.

Hoofdstuk 6 bespreekt een mixed-methodsstudie over een verbeterde MR-strategie die in hoofdstuk 5 voor laatstejaarsverpleegkundestudenten was ontwikkeld, ingevoerd en geëvalueerd. De centrale onderzoeksvraag die dit hoofdstuk poogt te beantwoorden is “Wat zijn de effecten van een in simulaties geïntegreerde, verbeterde mentale oefeningsstrategie op de studentprestaties en stressvermindering?”. In dit hoofdstuk wordt een MR-strategie ingevoerd als onderdeel van simulaties waarbij gebruik gemaakt

wordt van SP's. Dit hoofdstuk vergelijkt de effecten van de MR-strategie in simulaties met die van het *Airway, Breathing, Circulation, Disability, Exposure (ABCDE)*****-ezelsbruggetje op de prestaties en stressniveaus van laatstejaarsverpleegkundestudenten tijdens het beoordelen en behandelen van achteruitgaande patiënten. De in dit hoofdstuk beschreven studie heeft een mixed-methodsdesign bestaande uit een gerandomiseerde controlegroep met nameting gevolgd door individuele interviews. Er waren 32 laatstejaarsverpleegkundestudenten die aan de nameting deelnamen. Zij werden willekeurig ingedeeld in ofwel de groep met de MR-strategie in simulatie (MR-SP-groep) dan wel de groep met het ezelsbruggetje (ABCDE-groep). Prestaties werden gemeten met behulp van het RAPIDS-instrument; het stressniveau werd bepaald op basis van de *State-Trait Anxiety Inventory (STAI)*-vragenlijst, en hartslag-, systolische bloeddruk- en huidtemperatuurmetingen. Er waren 21 studenten die individueel werden geïnterviewd na afloop van hun negen weken durende klinische stage ten behoeve van het kwalitatieve onderdeel van de studie. Hiermee probeerden we zicht te krijgen op wat studenten vonden van de effecten van de strategie op stress en prestaties in werkelijke settingen. Er waren geen significante verschillen in prestatiescores tussen de MR-SP-groep en de ABCDE-groep. De uitslagen van de STAI en systolische bloeddruk-, hartslag- en huidtemperatuurmetingen lieten ook geen significante verschillen zien. Drie thema's die uit de interviews naar voren kwamen toonden aan dat de waarde die de deelnemers aan de MR-strategie toekenden grotendeels neerkwam op "het mentaal en emotioneel voorbereid zijn", "het zich herinneren en voor zich zien van de te ondernemen stappen" en "het verbeteren van de werkelijke praktijk".

Samenvattend waren onze bevindingen dat de MR-SP-strategie en de ABCDE-strategie ongeveer hetzelfde effect hadden op de prestaties en stress tijdens de behandeling van achteruitgaande patiënten. Desalniettemin duidden de interviews erop dat de MR-strategie het leren wel bevordert en ook voor andere opleidingen in de zorg een nuttige aanvulling zou kunnen zijn. In dit hoofdstuk wordt verder nog gezocht naar mogelijke redenen voor de afwijkende bevindingen, zoals het aantal begeleide sessies, het toetskarakter van de nameting en de afwezigheid van feedback wanneer studenten de MR-strategie individueel toepassen. De beperkingen van de in dit hoofdstuk besproken studie komen ook aan bod, zodat toekomstig onderzoek daar op kan letten.

In het laatste hoofdstuk, **Hoofdstuk 7**, worden de aan het begin van dit proefschrift gestelde onderzoeksvragen beantwoord en nader belicht. Verder bespreekt het hoofdstuk de samenhang tussen elk van de in hoofdstuk 2 tot en met 6 beschreven wetenschappelijke werken. Op basis van de uitgevoerde studies, concluderen we het volgende: 1) de effectiviteit van strategieën ter vermindering van stress tijdens simulaties verschilt per strategie, 2) toevoeging van SP's had geen invloed op stressniveaus en de prestaties, maar in de beleving van studenten vergrootten SP's de echtheid en bereidden zij hen voor op de werkelijke klinische setting, waarmee wordt aangetoond dat zij mogelijk van betekenis kunnen zijn in het opleiden voor de werkelijke praktijk, 3) de MR-strategie bleek alleen heil te bieden bij het verbeteren van de prestaties, ondanks dat studenten positieve effecten

op stress en de prestaties ervaarden, wat erop duidt dat een meer gedegen MR-strategie het leren, met name van hoe om te gaan met achteruitgaande patiënten, wellicht kan bevorderen, en 4) simulaties met SP's waarin de MR-strategie was opgenomen bleken niet beter te zijn dan de mnemonische strategie waarbij gebruik werd gemaakt van fantomen, ook hier ondanks de positieve ervaring die studenten ermee hadden, wat erop wijst dat het effect van de strategie op stress en de prestaties tijdens simulaties van achteruitgaande patiënten nader onderzocht dient te worden.

De voornaamste gevolgen van deze studies voor het gezondheidszorgonderwijs is het inzicht dat het mogelijk waardevol is om een emotionele trainingsstrategie die stress zou kunnen verminderen en in simulaties kan worden opgenomen om verpleegkundigen en uiteindelijk ook andere zorgprofessionals op te leiden, te ontwikkelen en constant te verbeteren. Een dergelijke strategie zou essentiële gevolgen kunnen hebben voor de behandeling en de veiligheid van patiënten, omdat een teveel aan stress de prestaties kan verminderen. In hoofdstuk 7 wordt ten slotte nog een voorstel gedaan voor de koers van toekomstige studies en hoe zij het beste voort kunnen bouwen op de bevindingen die uit dit proefschrift voortvloeien.

* HFS = high-fidelity simulators
** Rescuing A Patient in Deteriorating Situations (RAPIDS): Het redden van een patiënt die in achteruitgaande toestand verkeert.
*** MR = mental rehearsal
**** Airway, Breathing, Circulation, Disability, Exposure = luchtweg, ademhaling, circulatie, bewustzijn blootstelling.

VALORISATION

VALORISATION ADDENDUM

The research presented in this doctoral thesis addresses the importance of developing stress management strategies that could be utilised in health professions' curricula. These stress management strategies should be able to help trainees prepare themselves for actual clinical practice. Such a preparation is not just needed for technical skills, which could affect patient outcomes. It is also needed for non-technical skills, such as managing stress. Stress, at excessive amounts, has been shown to affect clinical performance in negative ways. Such a negative impact could have unfavourable consequences for patient outcomes. As such, patients could suffer more due to complications, prolonged hospitalisations, or possible frequent re-admissions. These less than optimum outcomes not only have impact on the patients involved, but also on their families who would be caring for them. Furthermore, poor patient outcomes adds burden to the healthcare industry in terms of costs.

The programmatic approach to developing a stress management strategy (Chapters 3, 4, 5, 6) that this thesis highlights could be used to develop similar strategies that train healthcare professionals to cope with stressful and emotionally-charged situations in clinical practice; situations that require them to think fast and act immediately. The emphasis of training, thus, should not only focus on the competent performance of technical or procedural skills.

The stress management strategy that has been developed and implemented for final year nursing students (described in Chapters 5 and 6) utilised mental rehearsal, which involves the repeated

visualisation of a task in the mind as a form of practice. This strategy was shown to be effective in other disciplines, such as sports and music. Mental rehearsal has then been integrated into authentic simulations to facilitate stress management and performance training of students. As mental rehearsal can be done independent of simulations, it is a cost-effective method of training that has the possibility of benefiting health professions' trainees.

TARGET GROUPS

As the main goal of this thesis is to address the emotional component of health professions' training, that is, to develop and implement a stress management strategy integrated into simulations, the primary target group naturally is the academic community which includes the *educators and the health professions students*. However, the thesis may be of interest to other groups as well.

Patients are the end-users of any healthcare service. As such, they are one of the main target groups that could benefit from the research findings. As patient outcomes may be affected by poor health professional performance due to stress, a stress management strategy that could be utilised in the training of health professionals could minimise the patients' risks for complications, prolonged hospitalisations, and hospital re-admissions.

Stress is inherent in the hospital setting. Hence, *individual hospital staff*, such as physicians, nurses, and those belonging to the allied health professions, may find some significance in the research's results. The mental rehearsal component of the strategy is very easy to

use any time in any place, and for hospital staff who are open to the idea of using the principles of this strategy in their own work areas, a workshop on how this strategy is applied in their setting could be done. After which, staff would be individually equipped to use mental rehearsal for the long-term as a stress management routine.

One group that may also be interested in the research results would be *hospital administrators*. Hospitals are sometimes burdened by patient re-admissions that strain hospital resources. Some of these re-admissions result from less than adequate patient management during prior hospitalisation, and as mentioned in the previous section of this chapter, healthcare professionals' excessive stress may have negative impact on performance, and consequently, to patient outcomes. A stress management strategy, therefore, such as mental rehearsal, has principles that are easy to understand, and with a practicality that makes it easy to integrate to hospitals' continuing training for staff.

Patient safety advocates may also be interested. One of the most common human factor errors that happens in the hospital setting result due to hospital staff stress. Because of this, advocates of patient safety or those in the hospital's patient safety committee may be interested to scrutinise this thesis to see whether mental rehearsal integrated into authentic simulations, or the principles of mental rehearsal, may be tailored and/or further developed to work for their unique setting.

Finally, *government agencies that regulate health professionals* may also be interested in the research results. These agencies pay close

attention to how health professionals are trained such that they could qualify as competent professionals in their area of specialty. Majority of the training programmes for health professionals focus on technical skills competence. However, expertise in procedural skills is not the only factor that determines the competency of the healthcare professional. Thus, regulating agencies may need to also consider mandatory stress management strategies, such as mental rehearsal together with simulation training, to be taught, not just as part of health professions students' training, but as an integral component of continuing medical/nursing/allied health education.

ACTIVITIES/PRODUCTS

This thesis comprises of a series of research that led to the development of the mental rehearsal strategy in patient deterioration simulations. These studies were conducted in the context of the Clinical Decision-Making module for final year undergraduate nursing students. The principles and the use of mental rehearsal in assessing and managing deteriorating patients have thus been taught to nursing students in said module in subsequent semesters after the research. The main products of this thesis, however, include papers that have been published in reputable journals, and the presentation of findings derived from the individual studies that comprise this thesis. These findings have been presented in local and international conferences, as well as in workshops on simulation that the author has facilitated. The aim of these presentations is not just to disseminate what has been done in terms of training health professions students to manage stress,

but to elicit an interchange of ideas that could further improve the stress management strategy that has been developed.

INNOVATION

The focus of the thesis is innovative as it tries to address stress management that seems to be lacking in health professions' training programmes. The application of mental rehearsal, a stress management and performance enhancing strategy that has been used successfully in other areas, such as sports and music, and its integration into a more complex patient deterioration simulation is something new.

SCHEDULE AND IMPLEMENTATION

As mentioned under a previous section of this chapter, the principles and use of the mental rehearsal strategy has been taught to final year nursing students in subsequent runs of the Clinical Decision-Making module. As this module, however, will be phased-out commencing on Academic Year 2017 - 2018 as a result of the switch to a new curriculum, the mental rehearsal strategy in deteriorating patient simulations may need to undergo further refinements so that it could be integrated into a new simulation-based module that prepares final year nursing students for clinical posting. It has also been suggested that the principles of mental rehearsal be taught to nursing and medical students to help them in their learning. There are also potential collaboration plans with clinical staff to integrate the mental rehearsal (as a stress management strategy) into their existing training

programme as it has been found that stress is one of the factors that negatively impacts on their performance-based training programmes.

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CURRICULUM VITAE

Jeanette was born in Manila, Philippines and currently resides with her husband and two children in Singapore. She completed a Bachelor of Science degree in Psychology from the University of the Philippines, Diliman, and later on pursued a Doctor of Medicine degree (MD) from the Pontifical and Royal University of Santo Tomas, also in the Philippines, which she completed in the year 2000.

After passing her physician licensure examination, she began her training in Anaesthesiology with the East Avenue Medical Center in Quezon City, Philippines, and was the Chief Resident of the Department of Anaesthesiology of the said medical centre in 2005. She did a part-time Bachelor of Science in Nursing degree after her anaesthesia residency, during the time she was starting her private practice as an anaesthesiologist.

In 2007, Jeanette moved to Singapore and started her career in the academe. She started out as a lecturer in the Alice Lee Centre for Nursing Studies, Yong Loo Lin School of Medicine, National University of Singapore, teaching post-graduate nurses in the Master of Nursing (Advanced Practice Nursing) Programme. Later on, she also taught in the undergraduate nursing programme, as well as in the undergraduate medicine programme. Her areas of teaching include health assessment, physiology, pathophysiology, and critical care. It was during these teaching exposures that Jeanette was able to develop keen interest in simulation-based education. She attended various international training programmes in simulation and tried to integrate

this pedagogical method in her teaching, primarily in the post-graduate programme.

In 2011, Jeanette was appointed in the Central Committee of the Centre for Healthcare Simulation, the simulation centre of the Yong Yoo Lin School of Medicine. As a faculty of the simulation centre, Jeanette was primarily involved in simulation programmes for undergraduate and postgraduate nursing students, and for medical students. She is also one of the facilitators for the faculty development workshops that the simulation centre organises regularly for local and regional health professionals interested in simulation.

Jeanette has also conducted simulation-based education workshops in Singapore, Thailand, Hong Kong, Japan, and the Philippines. Her research interest is focused on pedagogical innovations, and as such, has presented her work locally and internationally as well. She is also a recipient of educational grants that focus on teaching innovations.